20 Questions Toward Better Thinking: A Look at Internet Based Learning

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20 QUESTIONS TOWARD BETTER THINKING

A LOOK AT INTERNET-BASED LEARNING

A Synthesis Project Presented

by

ROBERT B. MENDELSON

Submitted to the Office of Graduate Studies, University of Massachusetts

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20 QUESTIONS TOWARDS BETTER THINKING

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ABSTRACT

20 QUESTIONS TOWARD BETTER THINKING

A LOOK AT INTERNET-BASED LEARNING

December, 1997

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Directed by Associate Professor Delores Gallo

New technology and good teaching practices must be combined to produce the most up-to-date and effective Internet-based learning. Critical and creative thinking techniques incorporated with technological enhancements will stimulate better comprehension of a variety of resources including in Internet-based learning.

Two key concepts of critical and creative thinking which I focus on are Metacognition and Frame of Reference. Metacognition is the self-awareness of one's thought process. It includes knowing why one makes decisions, what factors contribute to a choice, and why the opposite decision was not chosen. While most people disregard or ignore metacognition it can have numerous positive affects on one's thought process.

Understanding one's Frame of Reference is understanding oneself. Frame of Reference
factors include identifying one's personal goals, values, ideals, and personal experiences. It is influenced by experiences taught directly or indirectly.

To illustrate the integration of technology with critical and creative thinking in Internet based learning, I have created a computer simulation game based on the classic game of twenty questions. The computer will choose a topic from a random list of topics. The students will complete a form by selecting questions from a list of keywords. After selecting a question the computer will respond whether the question is true or false in relation to the topic. The game will stimulate thinking by incorporating prompts, called stimuli, which assist the student in understanding their biases and frame of reference when choosing a question. The stimuli will incorporate the critical and creative thinking concepts of Metacognition and Frame of Reference. The will be open-ended to provoke introspective thought.

The game runs on the teacher's Internet server and utilizes the TCP/IP protocol to connect one or many students to the computer. It will dynamically store the student's questions, answers and comments in the computer's database. The game utilizes the Web function of hypertext links to enable both the student and teacher to view his and other student's work. The links also provide connections to related subject-matter Web sites.
I would like to thank Dr. Steven Swartz and Robert Keith the members of my Synthesis committee, and to Dr. John Murray and Margaret Driscoll for their support and guidance. In particular, I owe many thanks to Delores Gallo, my Synthesis advisor, whose dedication and motivation were instrumental in my completion of this work.

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INTRODUCTION

Computer technology and education are in a unique state of evolution. Computers have seen tremendous growth since the original vacuum tube device that could only perform simple mathematical computations. This device occupied an entire floor and radiated enough heat to warm an entire building. The original computers could perform only simple mathematical computations, while today's computers can perform many highly-complex and interactive tasks. Modern machines are many times smaller, more efficient and have the ability to process thousands of events in a millisecond. Today's computers can simulate many common environments which were never thought possible in the past. The speed and abilities have been significantly increasing each year in the past ten years. These quantum advances have made computers an integral part of life.

By contrast, formal education has seen less radical and rapid change or growth. Education has been around for as long as humans stood up-right. Education for early man was in the form of apprenticeships. One individual would learning by observing another and gain knowledge through copying. For example, a novice blacksmith would learn skills by working side-by-side with the veteran blacksmith. Formal education evolved the direct observation method of teaching, to a classroom of books and testing methodology. This evolution took thousands of years. Even though formal education has been around for four or five hundred years, it has seen minimal radical changes.

Today's society regards education as an important discipline which all young children must experience for twelve or more years. Students begin their formal educational process around the age of three and continue well into their twenties. Often beyond primary, secondary and college-level most people attend classes throughout their lives. “The total spending on education in 1995 in the United States
reached $558 billion. More than half of this amount was spent on elementary and high school education.\footnote{Department of Commerce. 1995: Bureau of the Census, International Trade Administration.} Whether it is for pleasure, professional work advancement, or some other desired goal, education is important.

In this paper I will address how we can at this juncture, the close of the twentieth century, make the best use of the technical and educational opportunities available to us. I will begin by reviewing some widely held goals of education and their relationships to the development of critical and creative thinking. I will focus my discussion on the concepts and value of metacognition and frame of reference. Following that, I will review current projects using computer technology, specifically the Internet, as a vehicle for education. I will conclude by describing a computer simulation which combines both the critical and creative thinking concepts with available Internet technologies to produce a learning tool that stimulates metacognition.

The major contribution of this work is a computer simulation game I developed based on the classic game of twenty questions. The game runs on the teacher’s Internet server and utilizes the TCP/IP protocol to connect one or many students and to the computer. It will dynamically store the students questions, answers and comments in the computer’s database. The game utilizes the Web function of hypertext links to enable both the student and teacher to view his and other students work. The links also provide connections to related subject matter Web sites.

The students will access the game by connecting to the Internet and navigating to the appropriate site through their Web browser. The computer will choose a topic.
from the pre-loaded list of topics created by the teacher. The student will complete the presented form by selecting questions from the available list of keywords. After selecting a question and submitting the form, the computer will respond whether the question is true or false in relation to the topic. The game will stimulate thinking by incorporating prompts, called stimuli, which assist the student in understanding their biases and frame of reference when choosing a question. The stimuli will provoke the student's metacognition and awareness of their frame of reference. These stimuli will be open-ended to provoke introspective thought.

I will conclude by suggesting additional research and improvement to this computer simulation. I realize that this paper just begins to explore the concept of including critical and creative thinking ideals into Internet-based learning. The appendices will offer the reader a how-to manual for installing, preparing and playing the game, a protocol outlining a transcript of the game being played, a list of game topics, questions and associated stimuli, a glossary of computer related terms, and a list of academic institutions currently providing Internet-based programs.

**The Goals of Education**

It is widely accepted that education is more than the simple transfer of information from teacher to student. Memorizing facts without the ability to apply it in unique situations is useless. In a classroom the teacher must facilitate the students self-learning. The teacher needs to find unique ways in which to guide the student towards questioning and understanding new information. For the student, repetition of subject matter will not suffice. They must possess an understanding of the material. When teaching a subject the instructor expects the student to gain more than the skill of blindly "parroting." The student must be able to internalize the information and utilize it in new, logical and abstract ways.
Richard Paul calls this type of transfer, teaching critical thinking in the “strong sense”. He states that teaching must be designed “so that students explicate, understand, and critique their own deepest prejudices, biases, and misconceptions, thereby allowing students to discover and contest their own egocentric and sociocentric tendencies.”

Strong sense includes the ability to comprehend and evaluate with empathy multiple frames of references which represent differing opinions. Additionally, Paul asserts that students need the ability “to argue both for and against every important point of view and each basic belief or conclusion that they are to take seriously.” Students must be exposed to a spectrum of all issues related to a subject. They need to understand the origins of their opinions and facts. Academics normally tend to stress that all questions have answers rather than investigating all factors related to a topic.

A teacher has two distinct and equally challenging responsibilities relating to the education of students. First, teachers need to transfer factual information to the students. They need to augment and build the student’s current knowledge base. A detailed possession of facts, theories, vocabulary and reading skills is a necessity for every student. Combined with knowledge, a student needs the ability to think relationally. In order to do so, the skill to relate and think beyond the apparent must be stimulated or developed. It is imperative that students learn to take data and apply it to everyday life. Acquiring information without meaning is not effective learning.

A teacher must stress both knowledge and conceptual skills in the classroom. The two skills build upon each other. One skill cannot sustain without the other. Knowing how to think and relate facts are essential to learning and understanding. Modern education has focused on compiling a strong list of detailed facts to be memorized, rather than focusing on thinking skills. Although a strong and ever-increasing knowledge base is necessary, the skill of thinking and learning from facts is

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Importance of Understanding

Understanding enables students to do more with the presented information. They can compare and contrast it with information previously learned, and apply the data in abstract and practical ways. The goal of education is not just the transfer of knowledge; although it has a role in the process, but to stimulate the student to better understand. The student must have the ability to think critically and creatively about the topic. Without these skills the information the receive becomes trivial - a list of useless facts. Trivial information may be useful on a game show but it has no role in the productive world. Thinking enables one to analyze and comprehend a piece of information.

Jean Piaget, the French psychologist, and his followers argued that knowledge acquired by memorization is not real. Only information that can be used is real. Schools tend to focus on repetition which masks the failure to understand why procedures work or the ability to adapt them to modifications in how problems were presented. It is difficult to distinguish between repetition and understanding skills. Education needs to promote thinking instead of memorization.

Students must possess the skills to apply the subject matter in unique situations. Education and knowledge need to perform in unison. Without true understanding information looses practical meaning. Information is only of use if it can be applied and integrated with prior knowledge. The goal of education is to build highbred and creative thoughts; to make creative ideas by juxtaposing previous experiences and knowledge. Robert Root-Bernstein, a scientific historian notes:

1 Ibid.
“What is wrong, of course, is that ... students have learned to copy paths of reasoning worked out by others, but not to recreate or create for themselves as line of reasoning on their own. Their acquired skills are the skills of the forger or plagiarist, not those of the artist, writer or inventor. They have not been taught to think for themselves .... They have not learned to ask questions but only to give answers. They do not invent, but only repeat.”

Methods of Teaching

One key factor that affects the learning process is the method of teaching. Each student has unique educational needs. A single teaching method is not applicable for all learner’s educational needs and requirements. It is a misconception that the student can be shaped into the teaching model. It is more important to mold the teacher or teaching process to the student’s needs. Not every student will react identically to the same learning environment. Some students will excel in a traditional classroom environment while others will not. Often a student’s performance does not accurately depict his intelligence or learning potential. Student’s grades often merely reflect their ability to take a specific exam in the presented format.

Many activities can be set in place to stimulate thinking in multiple fashions. Teaching should be an active interchange between the student, peers and teachers to promote learning. Whatever the method of teaching, much emphasis must be given to activate relation of previous and new knowledge. New knowledge has little meaning without integrating it with previously learned information. Learning is a building process that feeds on past knowledge. It should also encourage the desire to continue gaining knowledge. Teachers need to develop methods of educating that will address both the transference of factual knowledge as well as stimulate critical and creative thinking. One ability without the other is incomplete.

There are numerous components that contribute to a teaching method; these include frame of reference, metacognition, and the educational environment. Both the teacher and student must be aware of these factors to better the Educational process. Even though the teacher may have stronger abilities to recognize these factors, both will benefit by its acknowledgment. Integrating thinking skills into a learning environment will address inadequacies in the educational process by stimulating better understanding.

**Seven Intelligences**

Howard Gardner, the Harvard Psychologist, outlines seven types of intelligence in his 1983 book called *Frames of the Mind: The Theory of Multiple Intelligences*. Students tend to learn using a variety of these skills yet traditional education only focuses on the first two. According to Gardner the seven intelligences are:

1. Linguistic
2. Logical-Mathematical
3. Bodily-kinesthetic
4. Spatial
5. Musical
6. Interpersonal
7. Intrapersonal

I concur with Gardner’s outline insofar as teaching must embrace multiple intelligences. Focusing on only one type in an educational environment is inadequate.

**Advances in Computer Technology**

The modern advances in computers and computer software can provide a magnificent opportunity for improving education for students of all ages. Computers and technology have infiltrated every aspect of modern life. Nearly everything in the

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modern environment has either been created or assisted by a computer. Many aspects of education can benefit from the aid of computers.

One of the most rapidly growing areas in technology has been the Internet. In the past five years it has evolved from an obscure tool for select physics professors, to shared research, to a household term. Today, one-third of all personal computer users have Internet access. This number is growing daily. Over the past three years there has been a great push to utilize the Internet. "President Clinton even jumped on the bandwagon with a speech in San Francisco last [year] in which he challenged 'business and industry and local government throughout our country to make a commitment of time and resources so that by the year 2000, every classroom in America will be connected [to the Internet]'". According to the American Internet User Survey daily use of email has increased from 47% to 59% while Web use has increased from 36% to 49%.

The Internet.

The Internet is a vast computer network linking numerous computers together enabling them to share data. Data is transferred using a common protocol called TCP/IP. TCP/IP can route electronic information or "packets" to any computer around the world connected to the Internet. There are numerous tools that utilize the protocol and network.

The most common method of data sharing is through a tool called the World Wide Web (known as WWW or The Web). The Web uses a simple computer language called HTML to publish text, graphics, sound, video and animation to anyone with Internet connections.

The Web presents its information through a software tool called a browser. Each user has a copy of this software on their computer in order to translate HTML code. There are many browsers on the market today. The user becomes familiar with a single Web browser and can access all Web page's multimedia information. The Internet browser translates the HTML code into visual format. One can also share data files through the browser using a common file sharing tool called FTP. Anyone has the ability to create HTML pages and share files.

The Web has a unique ability to link pages together in non-linear ways. These links called “hypertext links” enable the viewer to connect to another page from the original page. The hypertext appears to the readers as underlined words. The users can click on the link and jump from one page to another, while maintaining full control over the order in which information is presented as well as what information is presented. The manner in which the Web presents information is drastically different from the standard textbook. The page of a book is in sequential order (i.e. page ten follows page nine which follows page eight). A Web page can link to one or many other pages, there is no sequential order. The Web enables a freeform and user defined method of presenting information. The viewer has full control over how the information is connected. A book is limited in its presentation abilities. The Web breaks conventional boundaries of textbooks and other forms of media.

The Web distributes information worldwide to people at all hours of the day. The Web Server can serve up data to a person in India, the United States, South America or anywhere in the world simultaneously. The computer is not concerned whether it is 4:00 a.m. or 9:00 p.m. It takes its dictation from the user. The Web breaks conventional time and spatial boundaries. At this point anyone can gain access to this vast network of data with a telephone or Internet connection. Most people
subscribe to an Internet service through an Internet Service Provider (ISP) which is available in almost every country of the world.

By utilizing features of the Web, educators can break many boundaries of conventional learning environments. Currently classes are taught in a linear fashion similar to a book. Lesson two follows lesson one, minimal degradation can occur. Changes to the presentation of material affects all students. The Internet is not limited in this manner.

Electronic Mail or Email is an Internet tool that enables two or more individuals to share electronic memos. It is the Internet's equivalent to the Postal Service. The individuals need not be connected to each other. The Internet provides the common connection between the parties.

The Internet has many tools that utilize TCP/IP routing to provide a connection between two or more people. Chat is one of these tools. Also known as Internet Relay Chat (IRC), it is a tool that enables multiple people to communicate asynchronously. The dialogue occurs as text message sent to all members of the chat group at the same time. As soon as the person submits a message it is appended to the history of previous messages. The combined messages look similar to a movie screen play. Students can use this tool to have immediate communication to others around the world.

In addition to the Web, Cornell University's Dick Cogger and Tim Dorsey developed CU-SeeMe in the summer of 1992. CU-SeeMe is a free real-time video conferencing program utilizing the Internet. It enables anyone with a Macintosh or Windows based PC to video conference with another site located anywhere in the
world. The software requires a video camera, video digitizer, sound card and connection to the Internet. Due to the low cost of software many schools and universities have incorporated it into their Distance Learning programs.

**Building thinking skills through internet-based education.**

There are many examples of teachers using computers and Internet technology to augment education. Internet-based distance learning programs are similar to correspondence courses, except the students utilize the Internet for a more immediate exchange of material and information. The student and teacher may use email to exchange completed material on a regular basis. While these projects have made great strides in evolving educational methods; most programs tend to mimic the classroom environment using the available technologies. They have not evolved to include thinking skills.

Including thinking skills in an Internet-based education program will provide further advancements in these teaching methods. Computers provide a unique opportunity to include thinking enhancement skills to a curriculum. The device has many capabilities that conventional teachers do not. Computers can mimic numerous teachers methodologies of classroom presentation to numerous people around the world at a non-concurrent time. While computers and technology will never replace the conventional classroom, they can perform unique tasks that advances the traditional classrooms.

Some of the current projects utilizing technology in education are outlined in this paper. This discussion is augmented by including ideas for improving those environments by incorporating critical and creating thinking skills. Additionally, this paper demonstrates how current advancements in computers and specifically Internet
technology can integrate to further the progress in education. I will review techniques in critical and creative thinking which can be applied to improve one's thinking skill while learning an academic subject. Learning is more than the ability to blindly repeat. Larsen as sited by Fox declares that the confusion between knowledge and information "is perhaps one of the most serious and widespread mistakes in the current use of information technology, and it leads to the attitude that giving students information is identical to giving them knowledge." He notes that knowledge occurs when a person individually transforms information. Knowledge differs from information since the former is personal while the latter is public. Only information can be shared with others. The individual has the choice whether or not to convert the information to knowledge.

Many thinking skill elements can be included in teaching over the Internet which will greatly improve current distance learning projects. These elements include: metacognition and frame of reference. Championing thinking skills will further the effectiveness of distance learning programs.

Computers can provide a unique opportunity to teach based on the student's interest. Information can be presented in a non-linear fashion. The teaching can be presented differently each time the data is accessed. Computers can also simulate theories of thought process. Observation of a simulated thought will provide for better understanding of human cognition.

**METACOGNITION**

Metacognition is the self-awareness of one's thought process. It includes knowing why one made decisions, what factors contribute to a choice and why the

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opposite decision was not chosen. Most people disregard or ignore metacognition. There are numerous factors which affect one's thought process. These factors may create different circumstances as a reaction to the same stimuli.

Metacognition is defined as the self-awareness of one's thought process. It includes realizing why a decision is made or recognizing one's current mental state. It is an abstract concept that requires self-reflection and a tremendous awareness. Factors that can affect one's opinions include personal goals, values, biases and mood. Many of the inputs are difficult to understand or even realize. They are subtle and hard to notice within oneself. Introspection allows for a deeper understanding. Most people do not question where their thoughts come from. They are content with voicing views without pondering its foundations. Excluding metacognition stifles one's ability to understand.

The average person has little impetus to examine his thought process. Most learning environments do not champion or evaluate a student's metacognition process. Traditional educational methods fail to stimulate good thinking or metacognition. They tend to include much evaluation and opinions but provide the student no opportunity for self-evaluation or awareness. A traditional report card provides little motivation to question one's options and biases.

**Making a plan**

To be able to understand this process one needs to plan a strategy for tracking the sequence of steps of a planned behavior. Developing a plan documents the steps expected to occur in a particular task. An understanding of the steps to compare expected results with actual results is imperative. Since, metacognition includes self-reflection, documentation helps in understanding one's cognitive process.

By examining prior opinions, establishing objective criteria and analyzing post-viewing opinions, the student is forced to compare performance and results with
opinion. Explaining the sources of their biases is stimulus to metacognition. Identifying consistencies and differences from one’s pre- and post-experience evaluations stimulates self-awareness. Having the students recognize this process is a method of self-questioning. Re-examination of trends facilitates a student’s personal cognition.

**Monitoring**

Metacognition is the process of monitoring one’s thoughts, and understanding their origins in order to assist in creating new thoughts. Arthur Costa defines the importance of monitoring in metacognition as being able to:

> “both ‘look ahead’ and ‘look back’. Looking ahead includes: Learning the structure of a sequence of operation, identifying areas where errors are likely, choosing a strategy that will reduce the possibility of error and will provide easy recovery, identifying the kinds of feedback that will be available at various points and evaluating the usefulness of that feedback. Looking back includes: Detecting errors previously made, keeping a history of what has been done to the present and thereby what should come next, and addressing the reasonableness of the present immediate outcome of task performance.”

One method of stimulating a student’s understanding of the origins of their opinions, is to include a process to document the student’s personal opinions initiated prior to the introduction of a new topic. The student records his feelings about the forthcoming subject prior to it being taught. This documentation could be in the form of a questionnaire which has the student judge his personal values on the subject. This would include lists of what they like or dislike regarding the topic. All responses would be personal opinions of how they feel. No evaluation should occur. The teacher should not provide any input that would influence the survey. The goal should be to enable the student to document his personal criteria.

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Re-evaluation

Even with these additional steps included in a curriculum, there need not be any concrete evidence of metacognition. The student could simply create a plan and document progress without becoming aware of their process, or what influences their opinion-making process. They may not see their bias source or become aware of their mood. Students may not metacognize.

To address the above limitations an additional step of re-evaluation needs to be included in the process. In this section the student, after completing the prior steps, would explain any consistencies or discrepancies between their pre-subject evaluation of the topic with their current options. They should also include clarification of performance and evaluation results. They could provide this explanation in an essay format or another subjective method. The student would use their pre-evaluation as the basis of the explanation discussion.

According to Costa, reflections should include: “detecting errors previously made, keeping a history of what has been done to the present and thereby what should come next, and assessing the reasonableness of the present immediate outcome of task performance.”

Realizing the magnitude of metacognition and its potential insight to understanding makes one examine what methods can be used to measure progress in skill development or one’s ability to be aware of one’s thoughts. A computer can provide insight to metacognition thought by asking probing questions. It can ask open-ended questions to stimulate deep thought. The computer has the ability to use numerous methods to promote the students to question the origins of their thoughts. It can focus more on the student’s reason for answering a question rather than validating the answer. A computer can document how a student reacts to similar stimuli. The machine could track trends in behavior and make the student aware of them.

10 Ibid. pp 3.
Frame of reference is another critical and creative thinking concept that can be incorporated into Internet-based teaching. Understanding one's frame of reference is understanding oneself. Factors would include identifying one's personal goals, values, ideals, and personal experiences. Frame of reference is influenced by current events, or environments like temperature and personal comfort. All experience taught or ingrained will affect one's frame of reference. How much control does one have over their frame of reference?

Frame of reference is the identification of the contributing factors that affect opinions and interpretations. Understanding one's frame of reference includes denoting past experiences, values and goals.

Every person is influenced by their experiential and socially constructed frame of reference. This framework is "a set of basic beliefs, values, attitudes, and assumptions which explain, shape and reflect our view of ourselves and our world. [Frame of reference is] influenced by such factors as sex/gender, class, race/ethnicity, age, affectional preference, and nationality. Although one's [framework] can change, all individuals perceive and construct what they perceive, know, and value through some [frame of reference]."¹¹

Frame of Reference Elements

Frame of reference is a compilation of experiences and beliefs which has been internalized. Figure 1. illustrates the elements which combine to build one's framework.

Assumptions.

Initially on the left side of the figure is ones assumptions. This includes information that is unfounded. These factors make influences on interpreting information yet they have not gone through the intellectual process.

Biases.

The next section is bias; which are interpretations of the subject based on previous history. These biases may distort or clarify the topic. The individual is often unable to distinguish between reality and bias. Everyone has internal biases. Based on past histories and experiences people develop preconceptions towards objects, concepts and most things. Natika Newton states in her 1996 book Foundations of Understanding that our disposition is constructed by our sensory motivated experiences. When one communicates it is impossible to share information without filtering the ideas through biases and experiences. These attitudes are influenced by many factors. All dialogues are processed through the individual's frame of reference; which is developed and refined by external experiences. This filtering is a significant part of what makes up our personalities.

Methodologies and facts.

Methodologies are the procedures which the person uses to process, collect and interpret the facts. Methodologies are a resulting factor of one's frame of reference. It is a reflection of one's pre-conceptions towards a subject, manifested in words. A key element affecting better understanding is the realization of the intent's source. This realization refers to both the teacher lecturing and the student's listening. Educational content must be critically evaluated to decipher its meaning. This process includes understanding the word's intent as well as one's reaction to the word. Each factor of interpretation combines in filtering information. These methods will affect how the facts are represented. The individuals use of the facts will influence the facts. In many cases one cannot observe without influencing what is being observed. This fact must be included in the methodology section.
Beliefs.

“We go to the bible, we go through the workout
We read up on revival and we stand up for the lookout
There’s more than one answer to these questions pointing me in a
crooked line
The less I seek my source for some definitive
The closer I am to fine” 12

The Indigo Girls’ quote refers to a person’s quest to establish beliefs.

After processing the information through these levels of frame of reference a person builds his beliefs.

Frames of reference are the rules we follow when interpreting information. Mary Anne Wolff states that frame of reference is “the subject a person chooses to study and the kinds of information the person considers to be relevant to his or her belief and value systems. The interests embedded in that system influence a person to focus on some things and to discount others.” 13

Below, Delores Gallo identifies the factors which contribute to beliefs. She observes that beliefs are founded on assumptions and biases which are often hidden from consciousness. Nonetheless these two elements identify the methodology that is appropriate. Methods yield what the individual considers to be facts and on those facts belief is founded. For example, as westerners, we assume a scientific perspective is superior to non-rational ways of knowing. Therefore, empirical methods are most valued and offer the facts our public beliefs are based on.

Frequently one will assume that the preconceptions are negatively-based. However, a frame of reference need not be. The frame is just one's experiential interpretation of the data discussed at that particular moment in time. This attitude tends to change and evolve based on one's history and surroundings.

Examining one's Frame of reference also requires a level of open-mindedness. According to Gallo, open-mindedness:

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... requires engagement with the issue and investment in achieving a sound understanding that will permit action, while nonetheless demanding distance from any one perspective that might distort perception of the meaning and value of others. It is identified by an ability to probe persistently, yet regularly, to relinquish conceptions in the service of seeing things afresh. It is a posture of chosen commitments held concurrently with a willingness to be proven wrong. It is a capacity to gather information disinterestedly, sensitive to its limits and missing elements; a capacity to revise one's position to accommodate compelling new evidence and questions or new perspectives on extant knowledge.15

One needs to be self-aware of his disposition—the factors which make up one's opinions. Exceptionally open thinking can be manipulated by subversive concepts. Without critical evaluation of topics one can be susceptible to another person's evil whims.

One needs to be aware of the potential for manipulation by mass appeal and the implications of personal intent. For education to be useful, an understanding of one's frame of reference is necessary. Better understanding will foster critical and creative ideas.

When participating in an educational environment most people take understanding at face value. Little analysis occurs regarding how the presented information is interpreted. No attempt is made to critically evaluate the words and their subtle meaning. An analysis of one's frame of reference is needed to decipher how the data is being perceived.

Understanding one's Frame of Reference

We all begin our lives without a frame of reference. Young people have an innate sense of wonder. By their naive nature, children question their surroundings, with thoughts that range from theories on the meaning of life to the development of highly complex questions. These questions are natural, given that everything children are in contact with is new. They have no knowledge or background with which to

compare and contrast. A young person's frame of reference is unblemished and
without prejudice.

As children mature their litany of questions are answered by parents, teachers
and other adults. These resources provide endless amounts of information contrasted
with the youngster's prior knowledge or lack thereof. Through the years, children
develop their own answers and theories, with methodologies based on the responses
received from others. While growing up children are faced with taboo questions; ones
that are difficult to respond to such as what happens after death, and the meaning of
life. Most will receive placating answers or their questions are ignored entirely.
Eventually they learn to stop asking such questions and either accept the adult
responses without question, or allow religion to fill in the gaps of information. The
person will start believing that there are answers to all or at least most of their
questions.

As a child continues to mature he develops an arrogance of his ability to
rationalize answers to all questions. While his source of information frequently
remains parents, religion and elders; he soon recognizes the limits of their effectiveness.
Often, when a person graduates from high school he will feel invincible with answers
to all questions. This infallible sensation is prompted by a person being unconcerned
with true understanding. Too quickly cursory knowledge is accepted, without delving
deeper into the subject. Students tend to focus only on questions that they have the
resources to resolve, while questions requiring critical thinking are avoided.

An evolution occurs when students enroll in college. They start to re-evaluate
their sources of guidance. Students realize the limits in their knowledge source. The
inquisitive nature of critical and creative questioning is rekindled. Their currently
compiled and innate knowledge of the world does not comprehend the new
information discussed in higher levels of learning. They do not possess the in-depth
understanding to assist in processing the subject. This sensation is reinforced by the
professors and teachers not having every answer.
College-level studies often focus on research material that may not have provable answers. A college education makes one aware of the vastness of the world of information and sensitive to the fact that there are often no concrete answers. The realization of one's minuscule level of verifiable information versus the amount of available information is revealing and compelling.

Beyond college studies, people tend to become complacent in their knowledge. Their sense of natural wonder begins to abate. Matthew Lipman states:

"As adults, we have learned to accept the perplexities that emerge from our daily experience, and to take them pretty much for granted. Many of us no longer wonder why things are the way they are. We have come to accept parts of life as puzzling and enigmatic because that is the way they have always been."

"Many adults have ceased to wonder because they feel that there is no time for wondering, or because they have come to the conclusion that it is simply unprofitable and unproductive to engage in reflecting about things that cannot be changed anyhow. Many adults have never had the experience of engaging in wondering and reflecting that somehow made a difference in their lives. The result is that such adults, having ceased to question and to reach for the meaning of their experience, eventually become examples of passive acceptance that children take to be models for their own conduct."

Critical and creative thinking is necessary to remind one of their frame of reference and their sense of awe. People must be aware of their process of questioning, receiving answers, being complacent with those answers and finally re-evaluating the answers. One's collected pre-conceptions of answers often influence one into developing quick responses in order to facilitate the next subject. Realizing one's frame of reference forces one to question. By questioning, one does not take facts for granted and pursues information critically, seeking better understanding.

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REVIEW OF CURRENT PROJECTS

Currently, there are a tremendous number of education programs available on the Internet. It would not be feasible to provide an overview of each of them. At the rate the Internet grows there are hundreds of education curriculums added monthly. This paper will highlight a few programs which encompass the majority of activity types. It will discuss some key programs that incorporate many of the critical and creative thinking concepts outlined in the previous sections.

As an overview of the current projects using the Internet and technology for education I will first overview some active structure available to Internet users. My goal is to outline some of the common practices that are occurring in this form of education. I will also append some specific examples of programs using these practices.

Judi Harris of the University of Texas in Austin, states in her “Mining the Internet” column that The Computer Teacher divides Computer education into three primary categories: First, the Internet can be used for interpersonal exchange. Second the Internet is used as an information collection tool and finally there is a category which utilizes the Internet in problem solving projects. These groupings categorize most teaching projects currently seen on the Internet.

Interpersonal Exchange

Email

Interpersonal Exchange is one of the most popular uses of Internet technology. It encompasses using electronic mail or another tool to exchange information with one or multiple people. Email consist of electronic memos or letters which can be sent to one or many addresses through the Internet. Its concept is similar to writing a letter and sending it to another person through the mail. However, it has extended beyond conventional mail in that it allows the author to send the same message to many people. Email is routed much more quickly than traditional mail. An email message is sent between people in the matter of minutes. Another benefit to email is one can respond to a message by clicking a button and mailing back a response. Having the
message electronic enables it to be edited or have sections copied and merged with other messages.

Email can be used to provide one-to-one communication between students. This is where the student communicates to one or more people through email. It equates to an electronic version of a pen-pal. Individual students in two or more locations are matched with each other in order to communicate on a common subject. Students can share information and learn about others through this medium. A student at one location can send messages to someone across the hallway or across the world. They exchange data in a free form format. Topics, languages and dialogues are dictated by the students at each end of the messages.

Global Classroom programs extend the concept of one-to-one communication. The Global classroom is a structured activity where two or more classrooms located anywhere in the world can study a common topic. They can share what they are learning with other classrooms. Together each class gains from the experiences of the other and the dynamic between and among the groups. Since the Global classroom projects have more teacher’s involvement, they are more topic-focused than the one-to-one communication.

Both one-to-one communication and Global Classroom programs utilize asynchronous communication. Asynchronous refers to the fact that there is a disconnect or delay between the sender sending the information and the receiver receiving it. This choppy situation allows for information to be posted and read when most convenient. This flexibly facilitates self-paced learning.

KeyPals.

Interpersonal Exchange principals can be seen in a popular program called KeyPals International. College Bound created KeyPals four years ago as a service to bring students from around the world closer together with the power of email. The company connects two or more students together with similar interests. Students
exchange messages with other students from around the world. They share thoughts, personal and cultural opinions, and information over the Internet. The program's goal is to build better understanding by communication. The company also provides translation services among students of different languages, thus enabling students to communicate with anyone around the world. College Bound provides both the native language and English when translating a note.

**Mailing lists and bulletin boards.**

Email is just one example of using this technology. Mailing lists or listservs route information to many people about a common topic. Users signup for mailing lists and receive regular messages on the topic. Bulletin boards refer to email that is addressed to many users sends messages to them regarding a common topic. Interested students can visit the bulletin board and review the submitted data. Bulletin boards differ from Mailing lists in that they are a central source of information, versus sending numerous messages to everyone on the list.

**Real-time communication.**

Interpersonal Exchange can also be represented in an online lecture. In this example a conventional lecture is simulated using the Internet. Lecture notes are placed on line or downloaded as a file using File Transfer Protocol (FTP). The environment can be augmented with video or sound clips. By combining pieces of a conventional lecture the viewing student can get the sensation of attending the event.

Another concept in Interpersonal Exchange is an electronic appearance. This is where a celebrity or expert on a subject is available from a defined period of time to provide in-depth information regarding a topic. "Electronic appearance projects usually allow students to communicate with locally, nationally or internationally-
known people for relatively short periods of time.” The concept of electronic appearance can be expanded to include a regularly-scheduled availability of expertise.

This type of Internet communication is known as Mentoring. This is more than an appearance concept, in that the expert is available on multiple occasions. “A major benefit to online mentorships is the opportunity for frequent, convenient communication between mentor and student. Weekly or even daily journals and communications can be sent between mentor and student via email, providing an ongoing ‘dialogue’ which supports the development of the concerns and issues.”

**Question and answers services.**

Interpersonal Exchange also includes question and answer services. This is when one sends a question regarding a predefined topic to a specific email address and an expert responds to the question by responding to the message. There are numerous “Ask A” services available regarding numerous subjects. “Ask A Geologist,” coordinated by Rex Sanders of the US Geological Survey Branch of Pacific Marine Geology, allows pre-college students to submit questions that are answered by professional geologists.” These and other Interpersonal Exchanges can be found by using a search engine under the topic of education. See the following section for more information about search engines. Some of the services require registration or service agreements.

**Information Collections**

Information Collection allows students Internet methods for accumulating and sharing information. This data can be stored and organized in multiple fashions to assist the student in performing research and investigation during their education. Students can exchange data with other classrooms through email on a common subject.

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These subjects could include ideas like sports, science or more contemporary items. The students are both responsible for producing the exchanged data as well as receiving it. "Projects enable online learners to pursue special interests, to write or create for an audience and to publish or present their findings and conclusions via the Internet." 20

Collecting data creates issues of how to manage vast amounts of information. Too much information is useless if one cannot find the appropriate data when needed. One of the problems for the Internet is that it tends to provide vast amounts of data; occasionally too much data. Sorting and indexing the collection of information is a challenge. A database is a computer tool that allows large amounts of data to be organized. Students can learn how to use this technology while researching and exchanging information with other students. The database allows information to be stored and later retrieved through search and reporting abilities.

**Collaborative activities.**

Students can work together to build a common document like a newspaper, electronic journal or database. All students can contribute to the information organized within the database in a collaborative method. Databases can be shared with other students so they can be worked on simultaneously.

Students can also be observers of electronic field trips. This concept is similar to the common school field trip, except the student, teacher and school need not incur the costs and logistics associated with the conventional trip. An electronic field trip is where subject matter experts, while taking a trip, documents each endeavor of the trip. The expert either sends the documented information to the students via email or posts it on a Web site. During each day of the trip, information is updated based on that day’s experiences. In turn, students can ask questions by sending email to the experts throughout the trip. The expert will respond to the question. The expert becomes the

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student’s eyes and ears. The student experiences the field trip through the correspondence.

**MayaQuest.**

An example of an Information Collection, is represented in the MayaQuest Web site. This site examines how one of the world’s most advanced civilizations suddenly collapsed and disappeared. The Mayan people disappeared over a thousand years ago leaving little trace or reason. For the fourth year, MayaQuest is sponsored by The Learning Company’s MECC corporation. The program tracks the scientific expedition of archeologists and other experts through the rainforest and ruins of Central America. The scientists travel by mountain bike and traverse through Mexico, Guatemala, and Belize in search of lost cities and secrets. They research and uncover clues to the reason of the demise of the Mayan civilization. They document their adventures and communicate it back to students around the world. Students can manipulate the program by posing questions on the Internet to the archaeologists and explorers. They can share insights and pose questions in collaboration with students from around the world. During the expedition, the scientist immediately posts his findings onto the Internet through laptop computers with satellite modems. These modems can send information from anywhere in the world. Even after the tour is complete, students can experience it through MayaQuest Web site.

Another example of Information Collection is using the Internet to pool data for analysis. Students needing statistical experiments have numerous difficulties gaining vast and diverse amounts of data. Students can pool resources by creating a common survey and have other students at remote sites administer the survey. The collected data can be combined to provide better number and pattern analysis.

Students in locations around the city or around the world can get a diverse data set. Students benefit by seeing location trends or many strong data extrapolations. Students can share a common survey that is sent via email. This data is then entered into a database and analyzed. Or the database could be collections through a common
Web site reachable by the participating students. Each student would enter the collected data into the Web site which will act as the catalyst of data collection. Reports of trends and anomalies are derived from the data. Either method allows for vast amount of data to be collected. Statistically the larger the data sources, the better analysis can occur.

**NASA Mars explorer.**

NASA has also created Informational Collection Web sites that share data and images regarding the Explorer landing on Mars. Since the spaceship landed on the planet, it sends detailed reports and photographs from the surface. These electronic messages and images are posted on NASA’s Web site for all to observe. The space organization has organized a interactive feature to the Web site where students can learn about the mission by asking questions about the expedition. The site provides an experience similar to an electronic field trip to Mars. The Explorer landing has enabled all who are interested in visiting another planet without leaving their own atmosphere.

**Problem Solving Projects**

There are three key activities that are seen in current Internet-based education projects. They are informational searches, parallel problem solving and simulations. Each one utilizes technology to engage the student in active problem solving. These are the most promising examples promoting thinking and understanding. Unfortunately, the ease of the availability of technology may convince the teacher that the student is gaining skills, while in actuality they may simply be gaining the skills to use the technology while learning little of the subject matter.

**Informational search.**

Informational Search is one of the Web’s most rapidly improving abilities. The vast amounts of information on the Web is overwhelming without tools to assist with data location. The Information search tools create databases by scanning the Web and index key information from a vast number of sites. The search engines enable the user
to find, organize and preview the available information. They index and provide
criteria searches for finding information. Using these tools students can find
information on almost any research project. They will be exposed to the process of
identifying a problem, formulating search criteria, analyzing the returned data,
organizing the data and building cohesive reports of the collected subject matter.

Informational Search projects may be a part of a large research project or may
be in game format. These projects may involve one or multiple students trying to
complete the challenge. The student(s) use the Internet to gather data from Web sites
or work in conjunction with other students around the world to collect research data.

Search engines.

There are numerous examples of problem-solving projects in Internet
education. As stated earlier these are Web sites or other Internet programs that
promote discovery of solutions by using available technologies. A key tool of the
Internet that demonstrates this goals is the search engine. These are Web sites that
index all the sites available on the Web. Since there are numerous Web sites and more
are added daily, searching tools are necessary to sift through the vast amounts of data.
The original searching tool was called "Gopher". There are many Gopher tools
available to Internet users by most universities. The tool allows one to search for
information in a simple text-based environment.

As the Web's graphical capabilities became more popular a group of college
students at Stanford University built a graphical search engine called Yahoo. It
organized all Web sites into many hierarchical categories. It would update its lists of
sites daily. Yahoo enabled people to search the whole Web or within a specific
category. Soon other tools like Infoseek, AltaVista, Excite, and others were developed
that enable people to more easily find information. Students can use these tools in an
organized and individualized manner to better research and investigate, using the
Internet.
Parallel problem solving.

Another type of problem solving project that extends informational searches is parallel problem solving. In these activities multiple students or groups of students are given a problem to solve. They have a limited time to review and solve the problem, and later submit their results once the provided time has lapsed.

The subject matter and type of problem is irrelevant. The goal is not to focus solely on the first submitted correct answer, but rather all the results both correct and incorrect. The students try to focus on the method of problem solving rather than identifying the quickest solution. What is more important is the methodology used to solve the problem and that there may be many methods that yield the same result.

Earth day project.

As described in the previous sections, Parallel Problem solving are activities where similar problems are presented to student in several locations. An example of this type of internet-based learning is seen in the Earth Day project developed by David Warlick of Raleigh, North Carolina. In this program, students from many different grades and schools were challenged to develop "an imaginative new product that could make a profit, but not impact on the environment." The product must be user environment friendly and contain at least 50% recycled materials. Students submit both their solutions and their problem solving method. All solutions were shared via the Web site. Students cast their votes on the best products. Students were able to review other participants solutions and methods and nominated the most innovated product by placing fictitious orders.

Through this program the students obtained a level of metacognition by reviewing and observing multiple methods of arriving at a solution. The goal for the project was focused on creativity and originality and not results. By emphasizing the method of solving the problem rather then the solution students were receptive to multiple solutions. While comparing methods of solution, the students realized that the Earth Day, and most problems, have numerous correct solutions. By reviewing all
solutions they can see the benefits multiple perspective of problem solving. The students see that their solution is not necessarily better than the others.

Computer simulation.

Computer Simulation is another example of a problem solving project on the Internet. In these projects the students are able to simulate a virtual experience using technology. These projects simulated space shuttle launches, investing in the stock market, running a business and more. The student can experience a real-life external situation without leaving the classroom. Simulations provides a safe environment to test potentially risky situations.

The abilities of computers to simulate real life has been maturing rapidly. A computer reproduces sound, video, images and graphics to provide a realistic representation of the task. There are projects on the Internet that can simulate real-time three dimensional environments. Silicon Graphics have developed a programming language designed to simulate virtual reality worlds. Students can explore virtual worlds and gain knowledge and experience.

National educational supercomputing program.

Computer simulations can help students acquire skills by repeating an experience multiple times. The student can observe the results of their decisions during the progress of the simulation. For example, Linda Delzeit from the National Educational Supercomputing Program (NESP) coordinates students and teachers utilizing the supercomputer at Lawrence Livermore Laboratory through the Internet. These machines are some of the most powerful computers available. They have advanced simulation software which permit students to investigate climate modeling, molecular configurations and more. Students can glean realistic experiences testing these models from anywhere in the world.
Internet-based Distance Learning Programs

There are computer programs that are specifically created to assist with developing Internet-based education. These products are designed to utilize the available Internet tools and integrate them together with distance learning objective to create a remote educational environment. They assist the teacher in all the steps of developing a course including: Curriculum creation, course-related content organization, student organization, inter-student collaboration, facilitation of the learning environment, and assessment.

Some of these products include Lotus LearningSpace, Centra Symposium and Allen Communication's Quest Net+. Each one of these packages utilizes the Internet as an educational tool.

Lotus LearningSpace.

"LearningSpace incorporates the richness of group learning with the flexibility to support individual learning, all enabled by collaborative technologies. Its is a unique approach that allows new and rich forms of education to be offered by corporation and higher learning institutions to a diverse and distributed population of learners. Distributive learning uniquely responds to the needs of these learners for flexible, collaborative learning which can be accessed anything and anywhere." ²¹

Centra Symposium.

Symposium "combines live, instructor-led training with methods of continuous learning in one integrated, content-neutral environment. With Symposium the learning continues even after the live course ends. Symposium includes capabilities for self-paced CBT, moderated and free-form threaded discussion groups and off-line access to instructors, subject experts, chat logs previous lessons and other participants." ²²


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Allen Communication's Quest Net+.

Quest Net+ is a multimedia authoring tool utilizing the Internet built to "enhance the creation of interactive training and education application using an approachable, re-usable and extensive object-oriented architecture." 23

THE PRODUCT

Simulation over the Internet allows for a fun, interactive method for educational enhancement. To teach thinking skills, I have created a computer simulation application based on the child game of Twenty Questions that can be integrated with any Internet-base learning program. The program will utilize the Internet's capability of connecting the student to a central computer for sharing information. The system allows the students to enter data through any Web browser, process it on the remote computer and provide responses back to the student's browser. It will also have hypertext links to a help database with additional links to external references throughout the Internet.

Prior to allowing students to access the game, the teacher needs to populate the database with questions profiles. First, they must decide on a topic category. The category is open-ended and up to the teacher's discretion. This category could range from an animal to something more abstract like a problem or idea. The topic category can focus on any concept related to the course subject matter. After choosing the category, the teacher must create multiple topic profiles which relate to the topic category; which are entered through any Web browser. The teacher creates one profile for each true questions related to the topic. When creating a profile, the teacher can either choose a question from the list currently stored in the system or create a new one. The teacher will complete the form by adding a stimuli associated with each selected question. These stimuli should make the student question or realize why they choose the associated question.

After the topics and questions are in place, the student can use the game. He begins by connecting to the Internet and selecting the appropriate URL from his Web browser. The Web server randomly chooses a topic. The student can ask up to twenty true or false questions to arrive at the topic. Prior to providing the answer the computer will prompt the student with the associated stimuli. For example, the computer initially chooses the topic of a “dog”. The student may ask “does the animal live on land?” The computer would display a prompt with the following stimuli: “Think of three animals that do not live on land?”. After the student confirm reading the prompt computer would respond “True” to the question. The game continues until the student either guesses the animal or asks twenty questions. The game parallels the logic concept of a decision tree. Please refer to simulation protocol in the appendix.

To my knowledge there are no computer simulation projects designed to augment any Internet-based learning program. There exist computer simulations as described earlier, but this program is designed to be included with any distance-learning program. It is designed as a template which can support any topics or topic category. In other words, the topics can focus on any subject-matter from animals to quantum physics. The teacher has full control of the topics, questions and stimuli. The inclusion of stimuli promotes critical and creative thinking ideals.

Benefits

Much unnoticed cognition occurs to the student during this game. They have the objective of asking succinct questions that will produce the most illuminating response with a binary answer. Asking the question: “does the animal live on land” is a better question than “does the animal have wings”, since all animals either live on land or in water. The student wants to ask a question that will produce the best results. Since the goal of the twenty question game is to identify the topic in the fewest number of question the player wants to choose the broadest question at each interval. One goes through a rationalization when deciding on a question.
**Decision Making**

According to Mary Anne Wolff there are ten steps toward making a decision:

1. Define the problem and key terms
2. Consider a variety of options and for each
3. Recognize main reason / assumptions
4. Distinguish between factual and value claims
5. Gather data (observation sources)
6. Judge reliability of sources
7. Judges generalizations
8. Judge cause and effect statements
   a) Experimentation
   b) Analogies
   c) Others
9. Judge predictions
10. Weigh value claims
    a) Universal consequences
    b) Others

By understanding these decision steps, students can learn about their current knowledge base. One needs to know that animals either live on land or in water for this question to be most affective. Also, a person's biases are included in the process of generating a question. For example, to make the assumption that all animals live on land or water is not completely true. There are some animals like the frog which is born in water and matures to live on land. Most people make generalizations based on their biases about a topic.

The student playing the game will have a form where they select a question and ask the system whether it is true or false. The system will ask the student random questions, prior to providing the true or false answer, surrounding their frame of reference or metacognitive process of selecting the questions. The student can provide input to their reasoning of selecting. The game will continue until either the student guesses the topic or runs out of chances. Once finished with the game, the student can suggest additional questions, stimuli or comments to be included in future game sessions. The goal is to make the student aware of their process of decision making.
Both the student and teacher can review the completed game forms as well as the comments and suggestions. They can also receive statistics as to which questions were asked most and which questions were asked prior to guessing the topic.

Both the student and the teacher will benefit from this game. The student will gain an understanding of why they asked questions and what filters they used when processing information. Teachers will gain a clearer understanding of who their students are. Both teacher and student will be engaged in a thinking activity which will enable better understanding.

Stimuli

The program will stimulate self-questioning and analysis by prompting the student with thought-provoking questions prior to presenting an answer. The stimuli will provoke metacognition and thinking skills while presenting the users with abstract concepts and metacognitive cues while playing the game. A dialogue box will appear after the student submits their question to be answered true or false. These stimuli will be open-ended and provoke introspective thought. The stimuli encourages the student to either question, realize their personal thought process, or re-analyze the selected questions. The program may question the student’s bias or preconceptions. It will have multiple answers to allow for reflection on all potential and relevant outcomes.

Prior to allowing students to access the game, the teacher must populate the database with question profiles. First, a topic category is chosen. The category is open-ended and up to the teacher’s discretion. As described earlier, this category could range from an animal to a physical problem. The topic category can focus on any concept related to the course's subject matter. After choosing the category, the teacher must create multiple topic profiles associated with the topic category. The game provides a form to create a topic through a Web browser. The teacher creates one profile for each true question related to the topic. When creating a profile, the teacher can either choose a question from the list currently stored in the system, or create a

The teacher completes the form by adding a stimuli associated with each selected question. These stimuli should make the student question or realize why they chose the associated question.

The stimuli should encourage and facilitate better understanding by questioning the student's biases and frame of reference when choosing a question. During the game the student is not necessarily aware of his thought process when asking the questions. To make it useful as a thinking skill tool, the student must become self-aware of his thought process and frame of reference. The game requires many thinking skills that the student may not be aware of. The goal of the stimuli is to illuminate this unconscious thinking.

Since the teacher is responsible for creating the stimuli, it is imperative that he understands how to make one that will invoke the most introspective thought. It is therefore necessary to identify a framework to assist in their creation. There has been much research on what type of questions will stimulate thought. In order to help understand stimuli creation I will focus on two distinct stimuli types: Abstract and Metacognitive. Abstract stimuli provide further reflection of a student’s knowledge base. The goal is to have the player generate other, preferably more abstract associations and questions. Metacognitive stimuli calls for reflection on the student’s cognitive process -- his decision-making and use of language. The goal is to make the students aware of their process in order to execute it more efficiently.

How are stimuli questions formulated? There is no simple answer. Questions are combinations of words arranged in a sentence for the object of collecting information. Questions are used to interrogate or test assumptions. Teachers use questions to test or reinforce student's understanding. By contrast, students use questions to clarify information. The type of question and the format of the questions sentence will produce different experiences in the student. Students use questions as a guideline to particular actions, or for further investigation. Whether used by the student or teacher, questions produce an internal cognitive process.
Question stems.

There are three general types of question stems which will result in varying cognitive responses. Questions can be categorized into the type of thought process they produce. Some provoke critical thought, others stimulate creative thought while others are used to seek out specific facts.

The three general types of question stems tend to include characteristic words or phrases. These words exemplify the associated type of thought. For example, critical thinking stems include words like “how”, “why” and “do”. Creative thinking stems use words such as “suppose” and phrases such as “what if”. Factual stems include the words: “what”, “where”, “when and “who(m)”. Fact-seeking stems are the words that are included in research and news reporting.

In his 1989 book, Francis Hunkins further defines the stems into eleven detail categories of cognitive questions. There are question words that stimulate knowledge building, comprehension, application, analysis, synthesis, evaluation, receiving, responding, valuing, organization and characterization. The chart below lists numerous words applicable to each question type:
A teacher can use these cognitive question stems to formulate both abstract and metacognitive stimuli. For example, an abstract stimuli associated with the question “Does the animal have fur?” might be “What kind of animals have fur?”. In this case the student, by looking at the question abstractly, may realize the value of his question.

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Figure 3. Question Stems

A teacher can use these cognitive question stems to formulate both abstract and metacognitive stimuli. For example, an abstract stimuli associated with the question “Does the animal have fur?” might be “What kind of animals have fur?”. In this case the student, by looking at the question abstractly, may realize the value of his question.

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He may sort through animals with and without fur, or think of areas where furry animals live. He might think that fur protects the animal from the cold and then make the association that furry animals live in Alaska. This, in turn might provoke him to list numerous animals with fur. The student will become aware of their knowledge base and frame of reference, thus helping him guess the chosen animal.

A metacognitive stimuli to the same question may be “Is this a good question?”. This stimuli provokes different cognition. The student will reflect on the motivation of selecting the question. He will become aware of his process of question selection. He may choose questions that confirm an animal he believes is true. He may be randomly selecting the questions, or he may be choosing the broadest question hoping to eliminate as many potential solutions at each interval.

In the appendix List of Topics, Questions and Stimuli. These are the items used in my sample game which has a topic category of animals. Adjacent to each stimuli is noted its corresponding stimuli by type -- either abstract or metacognitive. Note that abstract stimuli tends to rephrase the questions in alternative ways; while metacognitive stimuli are more general. They do not refer directly to the related question.

The game assumes that learning how to question and better understanding ones thought process will help play the game. The stimuli will remind and question the students of their thought process. Using this simple computer simulation over the internet the teacher can stimulate better learning in Internet-based learning. It assumes that learning these skills may be transferable to other disciplines.

Next Steps

My proposed program will have the above-mentioned abilities. However, I do not have the time to aggressively test the benefits on a real Internet-based learning environment. To add further proof to my proposal, detailed data on student performance with and without the games involvement is necessary. Students and
teachers involved in classes using the game need to be surveyed for their criticism and input. Improvements to the game need to occur to better facilitate its goals. Statistical data needs to be collected on metacognitive awareness and improvement, and one needs to continually improve on the questions and the metacognitive questions to better stimulate critical and creative thinking.

Having this tool available on the Internet allows it to be incorporated into any Internet-based education program. While having fun, students may enhance their metacognitive skills. Over time it is hoped that they will require fewer and fewer questions to determine the end results. More importantly these developed skills will increase the students' self-awareness. They will become more in tune to their thought process of and more adaptable in future situations.

The program will be designed as a template for the questions; any topic can be used in the twenty questions simulation, in other words, the topics can focus on any subject-matter. The teacher will have full control of the topics, questions and stimuli.

CONCLUSION

Computer learning projects have evolved quite rapidly since the inception of the Internet. Over the past five years quantum leaps have been made at incorporating education, distance learning and the Internet together. This adds more functionality to the Internet, and teachers will incorporate these products into the learning environment. I hope my program helps Internet students develop thinking skills in conjunction with gaining knowledge. While, including new technology does not guarantee the student's ability to learn; critical and creative thinking will add value to the technology evolution by maintaining the focus on the student's ability to learn.

Education is the foundation of all human advances. It stimulates further advancements in every aspect of society. Technology, science, the arts and humanities all benefit from its advancement. Without education we are doomed to mediocrity. Improving a student's ability to think enables them to understand. Every aspect of life
requires the ability to understand. All presented information needs to be processed critically in order to internalize the information. It is dangerous to blindly accept data without questioning. Incorporating technology with learning will address two future issues. First, educators need to utilize new technologies to future advance teaching techniques. Secondly, students need to understand technology to become the future work force and society. "According to recent projections, only about 22 percent of people currently entering the labor market posses the technology skills that will be required for 60 percent on new jobs in the year 2000."26

System setup.

- Install and configure Lotus Domino server which is connected to the Internet. Consult the Domino administrator manual or your notes administrator for further assistance.

- Create a Person Document for each student and faculty member accessing the program. Be sure to complete both the “user name” and “HTTP password” fields.

- Create two groups in server’s Name and Address book. One group will be used for author access and the other for editor access to the system.

- Place all students into the “author” access group. Place all facility members into “editor” access group.

- Setup ACL with managers, “authors” group and “editors” group in both the Help and Project database’s Access Control List.

- Copy Help and Project databases onto Domino server in same directory. Directory name is not important. Both files must be in same directory.

Game setup.

- Open the Project database in Lotus Notes Client.

- Run agent to remove any old documents. Caution: this will remove all Question and Topic profiles.

- Edit the HomePage document to modify the first page which welcomes the user to the game.

- Choose a topic category. The system is created to handle any topic category. All created Topic Profiles should relate to a common topic category.

1. Select “Create Profile” to create first Topic Profile.
2. Fill in the first field with the topic chosen.
3. Either choose a question from the keyword list or enter a new question in the proceeding field.
4. If a new question is created, enter a corresponding stimuli.
5. Save the Topic Profile.
6. Press the “Create Another Topic” button to create another Topic Profile.
• Repeat these steps to create multiple topics. It is recommended that a minimum of six Topic Profile documents for each topic are created as well as least ten unique topics for the selected topic category.

Playing the game.

• Launch the Web browsers.

• Select the appropriate URL.

• Login to the Game by typing your login name and password.

• Select the “Start Game” image in the left-hand frame.

• The computer will choose a topic from the topic category and present you with the game screen.

• Choose a question from the question keyword list.

• Press the “Submit” button to process your selected question.

• The screen will reload and prompt you with a stimuli.

• Review the stimuli. Think about your thought and decision making process. Press the “OK” button.

• The screen will display whether the response to your selected question is true or false.

• Either guess of the topic, or repeat the above steps in the questioning process.

• Once you've guessed the topic, you will have the ability to offer feedback to your teacher in the “Suggest Question or Stimuli” field. Please provide feedback regarding your thought and decision-making process.

• To play the game again, select the “Start Game” image in the left-hand frame.
Simulation Protocol

Student: Connects to the Internet and launches his Web browser. Then, he types in the URL of the game's Web site.

Computer: Prompts the student for a login name and password.

Student: Types in Bart Simpson in the "name" field and Cowabunga in the "password" field.

Computer: Creates a three-frame Web page. The top frame displays the title, the left side provides navigation links and options and the right welcomes the student.

Student: Reads the welcome screen and chooses "Start Game" from the navigation frame.

Computer: Randomly selects the topic of a Cat from the available topics. Then, presents the student with the game form containing one keyword field with a list of questions and a field from which to guess the topic.

Student: Reads the on screen directions and chooses: Is the animal a mammal? and presses the "Submit" button.

Computer: Processes the submitted game form and computes, based on its database of information whether a Cat is a mammal. Once decided, it sets the stimuli prompt to Why was this question a good selection?, sets the "results" field to True, and returns the form to the student.

Student: Views the dialogue box with the stimuli. He ponders the question of whether all animals are mammals. He decides that there are other animal types including reptiles and birds. Then, he contemplates why he initially chose the mammal question. He thinks that the goal of question selection is to narrow in viable the possibilities and thinks his question was good. Then, he presses the "OK" button.

Computer: Presents the processed game form with the "results" field and another question keyword displayed.

Student: Still contemplating the process of question selection, he notices that the first question chosen was True. Next, he searches through the remaining questions looking for a question that does not relate to mammals. He chooses the question Does it eat meat?, then presses the "Submit" button.
Computer: Processes the submitted game form and computes, based on its database of information, whether a Cat eats meat. Once decided, it sets the stimuli prompt to How can you be sure an animal eats meat?, sets the “results” field to True and returns the form to the student.

Student: Views a dialogue box with the stimuli. He thinks about the types of mammals who eat meat. He decides that some mammals eat meat while other do not. In fact, some mammals in the same breed are carnivores and other are herbivores. For example, most whales eat plants, yet the killer whale eats meat. He then thinks of a TV program he watched the other day about bears. Bears primarily eat meat but in when none available it will eat berries. Then, he presses the “OK” button.

Computer: Presents the processed game form with the “results” field and another question keyword displayed.

Student: Still contemplating what it means for an animal to eat meat, he notices that the second question chosen was True. He starts to formulate what animals are mammals and also eat meat. He searches through remaining questions to choose the best question. He chooses the question Does it have a tail? and presses the “Submit” button.

Computer: Processes the submitted game form and computes, based on its database of information, whether a Cat has a tail. Once decided, it sets the stimuli prompt to Identify three animals that have tails and three that do not?, sets the “results” field to True and returns the form to the student.

Student: Views a dialogue box with the stimuli. He thinks about the types of mammals with and without tails. He thinks of a human, a bear, hamster, gorilla, horse, dog, and zebra. He decides that there are mammals with and without tails. Why did I choose the tails questions? What in my past, make me believe that knowing if mammal has a tail is informative? I guess, I thought most animals have tails. He then presses the “OK” button.

Computer: Presents the processed game form with the “results” field and another question keyword displayed.

Student: The animal in question has a tail. He starts to formulate what animals are mammals might meet these criteria. He catches himself walking through a farm looking for animals with tails. He searches through remaining questions to choose the best question. He chooses the question Is it cold-blooded? and presses the “Submit” button.
Computer: Processes the submitted game form and computes, based on its database of information, whether a Cat is cold-blooded. Once decided, it sets the stimuli prompt to *What are characteristic of cold-blooded animals?*, sets the “results” field to False and returns the form to the student.

Student: Views a dialogue box with the stimuli. He thinks about the characteristics of cold-blooded animals. He thinks of a snake. He sorts through his knowledge of a snake. A snake suns himself to keep warm. It tends to eat warm-blooded animals for food and heat. He then presses the “OK” button.

Computer: Presents the processed game form with the “results” field and another question keyword displayed.

Student: “Hmm... it’s not cold-blooded. Why is the mammal not cold-blooded? Wait a minute, mammals are not cold-blooded. Reptiles are cold-blooded. That was foolish. I wasted a chance. This time I will select a better question. He searches through remaining questions to choose the best question.” He chooses the question *Does it have legs*? and presses the “Submit” button.

Computer: Processes the submitted game form and computes, based on its database of information, whether a Cat has four legs. Once decided, it sets the stimuli prompt to *How does the animal if it looses one or more legs? How might I rephrase this question?*, sets the “results” field to True and returns the form to the student.

Student: Views a dialogue box with the stimuli. He is stunned by the suggestion of rephrasing the question. This game does not allow one to add or rephrase questions. “OK, if the animal is a dog. It would have four legs. So, the answer to this question would be True. What if the dog looses a leg in an accident. Now, this dog would only have three legs. So, the question would be False. Yet, a dog with three legs is still a dog.” This question can only describe an animal most common traits. A better way to ask this question may be *Does the animal have the common trait of four legs?* He then presses the “OK” button.

Computer: Presents the processed game form with the “results” field and another question keyword displayed.

Student: The animal has the common trait of four legs. Maybe the animal is a dog. He guesses that the animal is a dog. He fills in the guess animal field with the phrase: *Is the animal a dog?*
Computer: Processes the submitted game form and computes, based on its database, if “Is the animal a dog.” Once decided, it sets the response prompt to **Sorry, your guess is incorrect.** and returns the form to the student.

Student: Views the response dialogue box. He is saddened that his guess was wrong. He needs to find a good question. He searches through remaining questions to choose the best question. He thinks that maybe it is not a dog but a cat. To confirm his guess, the student chooses the question **Does the animal meow?** and presses the “Submit” button.

Computer: Processes the submitted game form and computes, based on its database of information, whether a Cat meows. Once decided, it sets the stimuli prompt to **Why does an animal meow?** sets the “results” field to True and returns the form to the student.

Student: Views a dialogue box with the stimuli. Meowing is a Cat’s method of communication. OK, the animal must be a cat. Then, based on his previous experiences with the game, he questions his assumption. He asks himself if the are other animals that: are mammals, eat meat, have a tail, four legs and meows. Satisfied that there are not animal with these traits, he then presses the “OK” button.

Computer: Presents the processed game form with the “results” field and another question keyword displayed.

Student: “I am going to guess that the animal is a cat.” He fills in the “guess animal” field with the phrase: “Is the animal a cat?”.

Computer: Processes the submitted game form and computes, based on its database, if “Is the animal a cat”. Once decided, it sets the response prompt to **Hooray, your guess is correct. Please submit your comment or suggestions** and returns the form to the student. Presents the game form with comment and suggestion field displayed for the student.

Student: Views a dialogue box stating that he has guessed the topic. He is excited that he guessed the animal in six chances. Then, he tries to formulate a suggestion for the teacher. He remembers the internal dialogue he had with himself about an animal that looses a leg. He makes the suggestion to reword the question in the following format: “Does the animal have the common trait of four legs?” He then presses the “Submit” button.
### List of Topics, Questions and Stimuli

<table>
<thead>
<tr>
<th>CAT</th>
<th>Does it eat meat?</th>
<th>How can you be sure that an animal eats meat?</th>
<th>Abstract</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Does it have a tail?</td>
<td>Identify three animals that have tails and three that do not.</td>
<td>Abstract</td>
</tr>
<tr>
<td></td>
<td>Does it have claws?</td>
<td>Compare animals with and without claws</td>
<td>Abstract</td>
</tr>
<tr>
<td></td>
<td>Does it have four legs?</td>
<td>How does the animal change if it loses one or more legs? How might I rephrase this question?</td>
<td>Metacognitive</td>
</tr>
<tr>
<td></td>
<td>Does it nurse its young?</td>
<td>What additional information can you glean from knowing the animal nurses its young?</td>
<td>Abstract</td>
</tr>
<tr>
<td></td>
<td>Does the animal meow?</td>
<td>Why does an animal meow?</td>
<td>Abstract</td>
</tr>
<tr>
<td></td>
<td>Is the animal a mammal?</td>
<td>Why was this question a good selection?</td>
<td>Metacognitive</td>
</tr>
<tr>
<td></td>
<td>Is the animal domestic?</td>
<td>Why did you choose that question?</td>
<td>Metacognitive</td>
</tr>
<tr>
<td></td>
<td>Does the animal have teeth?</td>
<td>How did you come up with this question?</td>
<td>Abstract</td>
</tr>
<tr>
<td></td>
<td>Does it have lungs?</td>
<td>What makes a question a good question to choose?</td>
<td>Metacognitive</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>CHICKEN</th>
<th>Does it have a tail?</th>
<th>Identify three animals that have tails and three that do not.</th>
<th>Abstract</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Does it have beak?</td>
<td>Explain why animals have beaks.</td>
<td>Abstract</td>
</tr>
<tr>
<td></td>
<td>Does it have claws?</td>
<td>Compare animals with and without claws</td>
<td>Abstract</td>
</tr>
<tr>
<td></td>
<td>Does it have two legs?</td>
<td>How does the animal change if it loses one or more legs? How might I rephrase this question?</td>
<td>Metacognitive</td>
</tr>
<tr>
<td></td>
<td>Does it have wings?</td>
<td>Have you wondered, why there are animals with wings that cannot fly.</td>
<td>Abstract</td>
</tr>
<tr>
<td></td>
<td>Is it a bird?</td>
<td>List characteristics of a bird?</td>
<td>Abstract</td>
</tr>
<tr>
<td></td>
<td>Does it lay eggs?</td>
<td>Why is this a poor question?</td>
<td>Metacognitive</td>
</tr>
<tr>
<td></td>
<td>Does it have lungs?</td>
<td>What makes a question a good question to choose?</td>
<td>Abstract</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>CRAB</th>
<th>Does it have claws?</th>
<th>Compare animals with and without claws.</th>
<th>Abstract</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Does it have six legs?</td>
<td>How does the animal change if it loses one or more legs? How might I rephrase this question?</td>
<td>Metacognitive</td>
</tr>
<tr>
<td></td>
<td>Does it live in water?</td>
<td>Think of three animals that do not live in water?</td>
<td>Abstract</td>
</tr>
<tr>
<td></td>
<td>Does it live on land?</td>
<td>Think of three animals that do not live on land?</td>
<td>Abstract</td>
</tr>
<tr>
<td></td>
<td>Does it walk sideways?</td>
<td>What kinds of animals walk sideways?</td>
<td>Abstract</td>
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<tr>
<td></td>
<td>Is it a bottom dweller?</td>
<td>Name seven animals that are bottom dweller.</td>
<td>Abstract</td>
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<tr>
<td></td>
<td>Does it lay eggs?</td>
<td>Why is this a poor question?</td>
<td>Metacognitive</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>DOG</th>
<th>Does it eat meat?</th>
<th>How can you be sure that an animal eats meat?</th>
<th>Abstract</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Does it have a tail?</td>
<td>Identify three animals that have tails and three that do not.</td>
<td>Abstract</td>
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<td></td>
<td>Does the animal bark?</td>
<td>Relate barking and non-barking animals.</td>
<td>Abstract</td>
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<td></td>
<td>Does the animal have a wet nose?</td>
<td>What kinds of animals have wet noses?</td>
<td>Abstract</td>
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<td></td>
<td>Is the animal a mammal?</td>
<td>Why was this question a good selection?</td>
<td>Metacognitive</td>
</tr>
<tr>
<td>Animal</td>
<td>Questions</td>
<td>Notes</td>
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<tr>
<td>DUCK</td>
<td>Is the animal hairy? Is the animal domestic? Does the animal have teeth?</td>
<td>Is the animal</td>
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<td></td>
<td>Does it have lungs?</td>
<td>domestic?</td>
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<td>Does it have</td>
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<td>domestic?</td>
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<td>Does it have</td>
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<tr>
<td></td>
<td></td>
<td>domestic?</td>
<td></td>
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<tr>
<td>HORSE</td>
<td>Does it have a beak? Does it have a tail? Does it have two legs?</td>
<td>Is it a bird?</td>
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<td></td>
<td>Does it have webbed feet? Does it have wings?</td>
<td>Does it have</td>
<td></td>
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<tr>
<td></td>
<td>Does it live on land? Is it a bird?</td>
<td>Does it have</td>
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<td></td>
<td>Does it lay eggs?</td>
<td>Does it have</td>
<td></td>
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<td></td>
<td>Does it have lungs?</td>
<td>Does it have</td>
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<tr>
<td>LIZARD</td>
<td>Does it eat insects? Does it have a tail?</td>
<td>Does it have</td>
<td></td>
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<td></td>
<td>Does it have claws?</td>
<td>Does it have</td>
<td></td>
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<td></td>
<td>Does it have four legs?</td>
<td>Does it have</td>
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<td></td>
<td>Does it live on land?</td>
<td>Does it have</td>
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<td></td>
<td>Is it a reptile?</td>
<td>Does it have</td>
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<td>Is it cold-blooded?</td>
<td>Does it have</td>
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<td></td>
<td>Does the animal have scales?</td>
<td>Does it have</td>
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<tr>
<td></td>
<td>Does it lay eggs?</td>
<td>Does it have</td>
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</tbody>
</table>

Propose why some animals have hair. Why did you choose that question? How did you come up with this question? What makes a question a good question to choose?
<table>
<thead>
<tr>
<th><strong>SNAKE</strong></th>
<th><strong>WHALE</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Does it eat meat?</td>
<td>How can you be sure that an animal eats meat?</td>
</tr>
<tr>
<td>Does it live in water?</td>
<td>Think of three animals that do not live in water?</td>
</tr>
<tr>
<td>Does it live on land?</td>
<td>Think of three animals that do not live on land?</td>
</tr>
<tr>
<td>Does it slither?</td>
<td>Distinguish between animals that slither and those that do not.</td>
</tr>
<tr>
<td>Is it a reptile?</td>
<td>Where do you get your knowledge of animals?</td>
</tr>
<tr>
<td>Is it cold-blooded?</td>
<td>What are characteristics of cold-blooded animals?</td>
</tr>
<tr>
<td>Does the animal have scales?</td>
<td>Why is this a good question?</td>
</tr>
<tr>
<td>Does it lay eggs?</td>
<td>Why is this a poor question?</td>
</tr>
</tbody>
</table>

**Abstract**

- Metacognitive
- Abstract
- Metacognitive

**How can you be sure that an animal eats meat?**

**Think of three animals that do not live in water?**

**Think of three animals that do not live on land?**

**Distinguish between animals that slither and those that do not.**

**Where do you get your knowledge of animals?**

**What are characteristics of cold-blooded animals?**

**Why is this a good question?**

**Why is this a poor question?**

---

**WHALE**

- How can you be sure that an animal eats meat?
- Abstract
- Are you aware of multiple animals with spouts?
- Abstract
- Think of three animals that do not live in water?
- Abstract
- What additional information can you glean from knowing that the animal nurses its young?
- Abstract
- Why was this question a good selection?
- Metacognitive
- How did you come up with this question?
- Metacognitive
- Identify three animals that have tails and three that do not.
- Abstract
- What make a question a good question to choose?
- Abstract
- What make a question a good question to choose?
- Metacognitive
Chat
Also known as Internet Relay Chat (IRC) is an Internet tool that enables multiple people to communicate asynchronously. The dialogue occurs as text message sent to all members of the chat group at the same time. As soon as the person submits a message it is appended to history of previous messages. The combined messages looks similar to a movie screen play.

CU-SeeMe
A free video conferencing program developed by Cornell University. The goal was to stimulate creative thinking and creating a wide base of users experiencing video conferencing. Video conferencing allows video, audio and text to be shared over the Internet.

Domain Name System (DNS)
DNS is a TCP/IP service that translates domain names to and from IP addresses. It is through the DNS that the domain name of every computer on the Internet gets mapped to its IP address so that each computer can send information back and forth on the Internet.

Email
Electronic Mail is an Internet tool that enables two or more individuals to share electronic memos. It is the Internet’s equivalent to the Postal Service. The individuals need not be connected to each other. The Internet provide the common connection between the parties.

FAQ
A Frequently Asked Questions list is a file that contains commonly asked questions and their answers. Typically, each newsgroup has a FAQ that answers questions readers have about or relating to that particular newsgroup. There are also FAQs that focus on questions new users have about newsgroups in general.

Firewall
A collection of components, typically a computer with a router, that filters incoming and outgoing network traffic to create a secure environment.

FTP
The File Transfer Protocol is a protocol used to transfer files from one computer to another. FTP also refers to the actual application used to move files using the FTP protocol.

Gopher
A popular Internet application that uses a menu system to allow users to search for and download information.
**Home page**
Generic term for the hypertext document users see when they first access the Web.

**Host name**
A term used to represent the name of the HTTP server.

**HTML (Hypertext Markup Language)**
The language used to write World Wide Web documents, or pages. It is a subset of ISO (International Organization of Standards) SGML (Standard Generalized Markup Language).

**HTTP**
Hypertext Transfer Protocol (HTTP) is the protocol used by the World Wide Web to transfer documents between clients and servers.

**Hypertext**
Text within an online document that contains links to text within other online documents; selecting a link automatically displays the second document.

**Hypermedia**
The collective term for creating links to and from text, graphics, audio, and video within online documents.

**Internet**
A group of networks that are connected to each other and span the world. Mostly, the Internet uses the IP protocol and other similar protocols. Through the Internet, users have access to services such as e-mail, file transfer, remote login, USENET news, the World Wide Web, WAIS, and Gopher.

**Internet server**
A host computer on the Internet that runs a network protocol, such as HTTP, to allow other computers to access its local information.

**Internet Service Provider (ISP)**
A commercial organization that provides you with services to connect to the Internet.

**Internet Protocol**
The Internet Protocol (IP) is the main protocol used to transfer information packets back and forth on the Internet.

**MIME**
The Multipurpose Internet Mail Extensions (MIME) protocol enables users to send multiple kinds of binary data (video, sound files, and so on) as attachments to an e-mail message.
Packet
A packet is a package of information that has been broken down by TCP in order to be transferred by IP. If you post an article to a newsgroup, TCP breaks down your article into small packets of information that IP then transfers over the Internet.

Ping
A PING utility sends network packets to a remote computer and requests that server to return network packets. One uses a PING utility to find out if a remote computer is available to establish a network connection.

PPP
Point-to-Point Protocol (PPP) is a dial-up connection protocol that enables you to use a modem to connect to other modems on the Internet. PPP is similar to the Serial Line Internet Protocol (SLIP), but is the newer protocol. PPP, unlike SLIP, actually monitors and verifies Internet packets as they are sent.

SLIP
Serial Line Internet Protocol (SLIP) is a dial-up connection protocol that enables you to use a modem to connect to other modems on the Internet.

SMTP
Simple Mail Transfer Protocol (SMTP) is part of the TCP/IP family of protocols and is the standard used for formatting and sending e-mail on the Internet.

TCP
The Transmission Control Protocol is one of the main protocols used on the Internet to break down data into individual packets of information that can be transferred using the Internet Protocol (IP).

URL
A Universal Resource Locator (URL) is the World Wide Web name for a document, file, or other resource. It describes the protocol required to access the resource, the host where it can be found, and a path to the resource on that host.

World Wide Web
The World Wide Web, or Web, is a wide-area hypermedia information retrieval initiative aiming to give universal access to a large universe of documents. To access the Web, you use a Web browser that provides hypertext links to jump to information on many different Internet Web servers.

Web Browser
A Web browser is an application that provides an interface to the World Wide Web.

Webmaster
The person who manages the Web site — similar to the network administrator.
Web publisher
Generic term for a tool or software package that converts documents to HTML so that they can be viewed on the World Wide Web.

Web Server
A Web Server stores the information accessible from a Web browser.

Web site
The set of pages that comprise a person or organization's presence on the Web.
List of Academic Institutions

Below is a partial list of colleges and universities that are currently using or researching Internet-based education.27

- University of Alaska at Anchorage (http://dist_ed.alaska.edu/)
  It makes sense that this school in its remote location has a "model" distance education program. They also have a useful Mega-links Index for additional distance education resources.

- Capital Community-Technical College, Hartford, Connecticut
  (http://webster.commpset.edu/HP/pages/darling/distance.htm)
  A comprehensive list of distance education resources, maintained by Professor Charles Darling Capital Community-Technical College Hartford, Connecticut.

- Danville Area Community College, Danville, Illinois
  (http://jaguar.dacc.cc.il.us/~ramage/dsted.html)
  A comprehensive list, containing links to distance education web sites that focus on the transmission of educational materials via compressed T-1, DS-3, and Microwave technology.

  A large site dedicated to the development of learning technologies. This site also has a useful education index.

- University of Geneva: Training Technologies and Learning (http://tecla.unige.ch/)
  The Education Technology index available at this European site is extensive and very informative.

- Howard University: Distance Learning Laboratory (http://stargate.con-ed.howard.edu/dl.htm)
  A distance learning site with a major emphasis on the application of Internet technologies to distance education. This site also has a distance education index to other resources.

- Indiana University: School of Education (http://www.indiana.edu/~eric_rec/prodev/de.html)
  This site is a good example of the state of distance education on the Internet today. The Indiana University, through the School of Education’s Distance Education program, offers beginning and experienced educators coursework that can be completed in their home or classroom at a pace that suits their schedules.

- LearnWell Resources (http://www.learnwell.org/~edu)
  LearnWell Online is part of LearnWell Resources, Inc., a California 501(c)(3) nonprofit corporation. It is approved as a Continuing Education Provider by the California State Board of Registered Nursing, CEP 11430. LearnWell also offers certified Continuing Education Units (CEUs) for educators, managers & other professionals.

- University of Michigan: Office of Instructional Technology
  (http://www.oit.irid.umdich.edu/Reports/DistanceLearn/index.html)
  A comprehensive white paper covering distance education and the application of video and cable technologies. This paper is a great starting point for understanding distance education.

• New Jersey Institute of Technology: The Virtual Classroom (http://www.njit.edu/njIT/Department/CCCC/VC/index.html)
  The NJIT offers classes through the Virtual Classroom system, which is an asynchronous learning network for collaboration augmented by video tapes to deliver class content.

• University of North Carolina at Chapel Hill: Institute for Academic Technology (http://www.iat.unc.edu/)
  The Institute for Academic Technology (IAT) is dedicated to the proposition that information technology can be a valuable tool for improving the quality of student learning, increasing access to education, and containing the costs of instruction. This site also has a distance education index.

• Nova Southeastern University (http://www.nova.edu/Inter-Links/education/distance.html)
  This site has a concise distance education resource index. This is also the home site for the Chronicle of Distance Education, an electronic magazine.

• Oberlin College (http://www.cs.oberlin.edu/)
  Third Stream Competing Online Learning Center is Oberlin College’s center for distance education.

• The Open University of the United Kingdom (http://www.open.ac.uk/)
  The Open University is Britain’s largest and most innovative educational and training organization. It leads the world in the large-scale application of technology to learning. The Institute for Educational Technology is the largest center for educational technology in the world and is currently researching distance learning solutions.

• Pennsylvania State University: The American Center for the Study of Distance Education (http://www.cde.psu.edu/ACSDE/)
  The American Center for the Study of Distance Education (ACSE) promotes distance education research, study, scholarship, and teaching and to serve as a clearinghouse for the dissemination of knowledge about distance education. The also produce The American Journal of Distance Education.

• University of Phoenix (http://www.uophx.edu/center/)
  The Online Campus has one of the most successful and widely recognized online degree programs in the world, offering working adults the unparalleled convenience and flexibility of earning accredited graduate and undergraduate degrees in business, management, or technology entirely online.

• Rochester Institute of Technology (http://www.isc.rit.edu/)
  The Rochester Institute of Technology provides has a substantial distance learning center and the Education Technology Center researches distance learning solutions.

• Stanford University: ADEPT Project (http://adept.stanford.edu/)
  The Asynchronous Distance Education Project at Stanford provides remote students with the opportunity to take certain graduate level Stanford engineering classes from their desktop computer.

• University of Tennessee (http://web.cc.utk.edu/)
  The Division of Continuing Studies and Distance Education at the University of Tennessee not only provides distance learning services, but also provides access to the Distance Learning Library.
• University of Wisconsin-Extension: Distance Education Clearinghouse
  (http://www.uwex.edu/disted/home.html)
  The Distance Education Clearinghouse allows users easy access to a wide range of information about
distance education. This website brings together distance education information and resources from
Wisconsin, national and international sources. New information and resources are being added to the
Distance Education Clearinghouse on a continuing basis.

• York University (http://www.yorku.ca/teachtec/)
  The Using Technology in Teaching forum maintained by York University provides access to research
and resources on distance education solutions.
BIBLIOGRAPHY


