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Information Retrieval Using the Constructivist's Approach to Get the Most Out of the Internet

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INFORMATION RETRIEVAL USING THE CONSTRUCTIVIST'S
APPROACH TO GET THE MOST OUT OF THE INTERNET

by

Ishani Shukla

A thesis submitted in partial fulfillment
of the requirements for the degree
of
MASTER OF SCIENCE
in
Management Information Systems

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UTAH STATE UNIVERSITY
Logan, Utah
2009
ABSTRACT

Information Retrieval Using the Constructivist’s Approach to Get the Most Out of the Internet

by

Ishani Shukla, Master of Science
Utah State University, 2009

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Department: Management Information Systems

The constructivist’s theory and its application to information retrieval from the Internet was reviewed. The main aim of the study was to devise and test an approach with which the most relevant information could be easily and efficiently extracted from the Internet. The impact of a judicious choice of the keywords to retrieve information, according to the particular approach to be implemented as well as the importance of speed reading as an additional technique to improve information retrieval, was compared and critically analyzed. The study was based on information retrieval from www.google.com and www.images.google.com and focused on real-life examples and goal-directed searches. After a careful selection, the criteria used for evaluation were factors such as data quality, accuracy, integrity, and speed of retrieval. These factors helped to determine how useful the constructivist theory could be in information
retrieval if it was to be applied in combination with speed reading and traditional approaches.

(123 pages)
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Ishani Shukla
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CHAPTER 1
INTRODUCTION

The world is full of information. Getting the most out of it is what counts. It is easy to grasp information when it is presented in an orderly manner. However, when there are several researchers working in the same or related fields, it also becomes a challenge. The information is found to be spread over a large number of files, documents and papers. For a new study, the bits and pieces of information can prove to be as important as the pages of descriptions.

During the last few decades, the dependency to obtain information from the Internet, and hence for acquiring knowledge, has increased significantly. This is rightly so because the Internet has become a good storehouse of information. One might easily assume that information retrieval is the job of search engines but this is not actually so. The techniques or approaches employed by the searcher are equally important. To evolve and use an efficient approach within the criteria, after the first search has been completed, is one of the main purposes of this study. We can only imagine all the time saved if the relevant information can be obtained in seconds. The computerized methods are based mainly on word searches and often end up giving lots of redundant information. The present study shows that the constructivist’s learning theory can be used as a tool to help in the information retrieval process and that it can considerably improve the quality of data collected, if it is applied along with the traditional learning methods. It is felt that many of the hurdles faced in information retrieval can be overcome by the correct use of this learning theory. Since learning is an internal and individual experience, this study
shows the approach to develop a totally new learning concept based on constructivism. Schematically, it can be represented as a combination of three steps as given in the flow of the study in Figure 1-1.

In the very first step of collection of facts, the process of identifying or styling the information to be collected is important. If one’s own discretion is used in retrieval, without proper training and application of the theory, which is normally the case, then the search may not be efficient. This is demonstrated by carrying out real-life experiments (chapters 2-5) and the results can be easily understood.

The idea of constructivism is to create more flexible minds. This system would encourage learning on one’s own specific requirements. Computerized methods give idle time and disjointed attention to the learner. Tendency for repetition of sites, as encountered in word searches, will decrease by the use of the constructivist’s approach.
This would inspire people with ideas to come into play, besides saving of time and energy spent in the search process itself. Further, the process of information retrieval, while using the constructivist’s approach, can turn out to be more meaningful because of its greater correspondence with facts, truth or information being searched.

As things stand at present, a considerable amount of energy and time is being wasted just to get the right data. The automatic search engines use ‘word search’ as the main criterion, but the results of the search are often confusing. Even in a simple Google search, pages of websites flood the search criteria and one is left with choosing the first three-four sites on the first page listed. The unconnected topics listed in the web list divert the attention from the main topic. The constructivist theory has found befitting applications in many areas of teaching and learning and can be applied suitably for improving the efficiency of information retrieval processes as well.

Knowing how to approach to learn and gather information on a new topic is important. It is hard to assimilate facts from the multitudes of sources, especially when the effort is not well guided. One ends up in the loss of focus on relevant details when acquiring information from the Internet. This study attempts to overcome the hurdles in information retrieval from the Internet and provides an easy way to learn based on what the learner thinks is important. This learning process itself becomes more enjoyable. The constructivist’s theory, when applied, can help to teach the mind the grasping power of information retrieval, thereby leading to a sharper learning capacity.
In short, the present work focuses on how the right combination of the traditional and constructivist’s approaches can result in an instantaneous application of the mind, such that one is not compelled to read loads of unrelated information.

1.1 Problem statement

Surfing on the Internet has been in use since a long time now and has been established to be a good approach for information retrieval, be it for simple surfing for fun, or to obtain relevant data on a specific topic. The use of the Internet is increasing day by day (Leiner et al., 2009), so much so that in most of the studies the first usual step has now become to browse the Internet as a quick and primary source of existing data. It is obvious, however, that since there is so much of data available on the Internet, it has become difficult to access and read each document even for a short while and then to choose the required material. It appears that information retrieval is gradually descending into trivia, thus giving the impression of being scattered, flaky, and inconsistent in the user domain. The basic competition amongst the Internet service providers is to provide the bulk of information, as voluminous as possible, rather than quality or appropriateness. The process of assembling and providing information on the Internet site by the site owners and the process of retrieving the required information from the Internet by users utilizes many methods. Generally, as an Internet user, people use automated searches or search engines to retrieve the information they want from the Internet through ‘keyword’ searches.
This study focuses on examining if the process of information retrieval can be made easier and more complete by using the constructivist’s approach. The constructivist approaches a learning theory that is based on combining one’s own experience of the subject with new material to be learned. This study shows that application of the constructivist’s approach leads to better choices in the process of retrieving and selecting information. The objective of the study is also, therefore, to evaluate, amongst the wide variety of choices available, whether or not this learning theory actually helps the learner to acquire more useful information and, thereby, augment both the quality and quantity of data gathered with less amount of energy and time spent on the search.

The constructivist’s theory is expected to develop sharper learning and applying capacities by knowing what is important out of a huge amount of given data. When applied to specific topics, the constructivist’s theory should make the search process faster and more accurate. In addition to this, there will be more choices in the ways to look for information efficiently. Besides making the search process easier, the theory may help to generate more criteria to search intelligently.

1.2 Historical development of the constructivist’s theory

It is interesting to trace back the history of the concept of “constructivism” from the point of view of philosophy, and, also know about the individual’s learning capacity and the influence of society on the learning process.
1.2.1 Philosophical aspects of constructivism

According to the studies by Oxford (1997) and some of the earliest views, constructivism is a philosophical belief that “people construct their own reality.” This is how the concept of “construct” came into being and it implies that there is no whole truth that can be perceived beyond the constructive powers of the mind of the knower. Glasersfield (Warrick, 2007) studied constructivism by defining its two basic roots, namely, ontology and epistemology. Ontology, deals with questions related to “Being” and the nature of “Reality” itself. There was a belief in “idealism” which was actually a branch of this root. According to this belief reality is simply an ideal and depends on the observer himself. The thought of constructing an ideal may therefore vary from person to person. The second root, Epistemology, deals with issues such as the validity of knowledge, its origins and limits (Ozmon & Craver, 1999). It is concerned with the transmission of knowledge, with the knower contributing to the knowing process itself. It refers to the interactive aspect of constructivism between the knower and the surroundings. The concept of “constructivism” in the learning process has, thus, its deep roots in ontology and epistemology.

There is another type of portrayal of constructivism in the examples of Sophists and Socrates (Warrick, 2007). The views of Sophists were that knowledge took the form a “travelling teacher”- a term used to suggest that lectures and models were mediums or helpers of the knowledge to be transmitted. It was based on the assumption that knowledge was out there in the surroundings, outside a person, and that this could be usefully employed to one’s own benefit. On the other hand, Socratics had a firm belief
that learning was totally an inner experience. The followers of the teachings of Socrates believed that the inspiration of why one wants to learn (or the motive behind learning) is more important than what is learned.

1.2.1.1 Role of individual’s ability to learn

Vico in 1710 (Warrick, 2007) coined the term “constructivism.” A treatise was published by Vico (Lo, 1996) which proposed that “knowledge was something that is constructed by the knower.” This definition is very close to the modern one. Piaget’s theory of knowledge (Piaget, 1973) suggested that the outside world totally depends on an individual’s capacity to learn, thus focusing more on the individual learner. A parallel was drawn between biological development and cognitive development. The similarity between the two lay in the process of adaptation to the environment, whether of the mind or of the body. The indirect effect of the social aspect came from the possibility that knowledge could arise from social interactions as well. It is surprising to learn that both Vico and Piaget themselves were not considered as constructivists in their time.

The importance of knowledge interaction within the social structures, including schools, grew rapidly. The involvement of groups had a big effect on constructivism itself, as suggested by Dewey and Vygotsky (Oxford, 1997). The effect of the use of constructivism in schools has been varied. The old way of teaching according to procedures, often called “proceduralism,” deals more with finishing the task. On the other hand, constructivist based teaching focuses on the student. Dewey (Oxford, 1997)
extended this principle to include people interacting within groups and then with the 
world at large.

According to Piaget (1973), the practice of constructivism lays a lot of stress on the 
spontaneous learning part of a child. He asserted that while following constructivism, it is 
not necessary to have either empiricism, or the experience of the senses (as the source of 
knowledge), or the inborn (or the inherent) qualities of innateness. His theory is said to 
match the student’s way of thinking and development in which the student understands 
by reconstructing and then rediscovering it himself from the knowledge being conveyed. 
This knowledge content could further progress to very complex levels by increasing or 
changing cognitive structures of the students. Piaget thus proposed that it was not the 
information gathering process alone that matters. According to him, information 
assimilation is dependent on a person’s learning capability as well as on the constructive 
and rediscovering capabilities of the mind, which when applied, could rise to even more 
complex levels. These were the facets of “individual” based constructivism developing at 
that time, with newer ideas, now and then, added to it by other thinkers.

1.2.1.2 Impact of social interaction on learning

Vygotsky (1978) looked at the combination of information gathering and acquiring 
knowledge aspects and claimed that the thought process depends on the maturity of an 
individual and on the impact of the experience gained from social interaction (Manus 
,1996). He was known to be more of a “social constructivist” because he suggested that 
“constructs” mainly had social origins which were actually rooted in the interaction with
others (Oxford, 1997). In this respect, the ideas of Vygotsky were not on the same lines as Piaget. Even though there is an apparent similarity in their views on learning from the experiences per say, the difference is that Vygotsky depended more on the social aspect of constructivism, as against only the individual learning aspect suggested by Piaget. According to Manus (1996), Vygotsky (1978) perceived that an individual’s consciousness developed more from mediated activities involving social interaction. These activities later on developed into greater levels of cognitive functions. He put forward the concept of the zone of proximal development (Vygotsky, 1978) and defined it as the difference between the actual development (during problem solving) and the potential development under the guidance of society or with social interactions. In this way, Vygotsky emphasized more on social constructivism. Even today, Vygotsky’s thinking has a great influence on designing learning programs for communities, corresponding to their societal backgrounds. This is one of the reasons why many forms of society based constructivism still exist today.

From the above discussion it clear that there are many interpretations about the basic nature of constructivism (Brooks and Brooks, 1999) but it is also clear that in constructivism the learning experience itself, of an individual as a single entity or by an individual in a society, is more important than the teaching methods which are employed.

While keeping in mind the historical aspects and also the multi-dimensional nature of constructivism, we need to examine how it relates to learning methods in the modern world of the Internet today. It will be interesting to see if there are any patterns of the past
that are still present and relevant in the learning and teaching methods today (Luhn, 1997; Mooer, 1959).

The following simple steps can be pursued to apply constructivism in information retrieval. The very first step is the proper selection of keywords. If the person retrieving the information has some prior background knowledge or information about the subject then through his own conceptual perception a set of linked keywords with some meaning (connecting the keywords themselves) can be made and inserted into the search engine or website. These connected keywords act as the basic conveyors of ideas for search. In the very first step itself the number of websites that will open will be fewer and relevant to the subject.

The next step is the selection of websites presented on the screen. Before selecting any website, speed reading is needed to scan the first few pages or so. The way the search engines are designed at present, in most cases the first page would contain the relevant website pages. By opening the sites and just glancing through the material, the search process can be further sharpened.

In the constructivist approach, time for reflection and thinking is needed to assimilate the information presented. The important part over here is the organization of the information in the search engine itself. If the search engine is designed to respond in a constructivist way then it will pose questions to the retriever, remember his past questions (or key words) and link these together to present more websites in the next attempt. Thus a search process itself needs refinement in first few attempts. This initial analysis of websites is crucial in deciding the final list of websites to be referred for a particular idea.
Delay times of small orders in the initial website selection process can be ignored because it will ultimately save more time. The websites selected in the first few attempts need to be examined and studied in more detail, rather than rummaging through the scores of unrelated websites.

Finally, the most relevant website should be considered first and more time should be spent on it in designing the next search step. The results of search will depend upon the experience or background knowledge of the retriever, his fast learning capability from the data presented and also his capacity to do speed reading with concentration to conclude fast during the search process. According to constructivism, the learning process is internal to the retriever and thus the efficiency of search process has an element of subjectivity built into it. This is true of all learning processes and hence the search on the Internet is also not an exception to it. However, with the application of constructivism the search process becomes enjoyable and engrossing, irrespective of the intelligence learning rate of the retriever.
CHAPTER 2
FORMULATION OF ON-LINE EXPERIMENTS TO STUDY THE ROLE OF
CONSTRUCTIVISM IN INFORMATION RETRIEVAL

2.1 Identification of the parameters for conducting experiments

The connection between the information retrieved and the retriever himself is rather complex because, during an experiment which is conducted on-line, the individual himself can exercise an influence on the retrieval process in several ways. It is, therefore, first necessary to understand those parameters through which the individual can be trained to act consciously for ameliorating the quality and efficiency (in content and speed) of the information retrieved. In this light it is also necessary to analyze the connecting links between information retrieval and (a) conceptual perception (what the individual wants to learn), (b) insightful examination (of different things he observes), (c) the process of dynamic testing itself and, lastly, (d) the actual occurrence (i.e. the transfer process). This scheme of connections in which the parameters (a)-(d) act as nodes is given schematically in Figure 2-1.

The interface between the nodes of conceptual perception and insightful examination can be represented, as given in Figure 1-1, as “logical integration,” between insightful examination and actual occurrence as “conflict,” between actual occurrence and dynamic testing as “social adjustment,” and, lastly, between dynamic testing and conceptual perception as “practical approximation.”
A similar construct has been proposed Schaller and Allison-Bunnell (Schaller, & Allison-Bunnell, & Borun 2005). The attempt in this work will be to evaluate the performance of the traditional and the constructivist’s approaches at each of the nodes. The basic premise is that the constructivist’s theory focuses on the background and experience of the person engaged in retrieving information. The implications of the different nodes given in Figure 2-1 are studied one-by-one.
2.1.1 Constructivist’s approach in conceptual perception

Conceptual perception deals with what an individual actually gains when the information retrieved after the search result is presented. Information retrieval can give rise to pieces of information that can be interpreted in different ways. Even the keywords can be chosen according to one’s conceptual perception of an idea or of the subject matter. By logically integrating what a whole idea conveys to a person, the search process can be made more efficient and hence prove to be more helpful. The parameters to be examined are:

a) Keyword selection: Keyword selection is one of the important parameters of conceptual perception. This is the starting point of the journey of quest for knowledge, information search and information retrieval. People construct different meanings of ideas when they choose keywords. However, for the retrieval process, keywords have only a literal meaning associated with those few words. The link between the keyword chosen by an individual and the results produced by site may not match. This will reflect upon how the site contents have been stored and how they are related to the keyword combinations. The domain knowledge of the creators of the site plays an important role here.

b) Cultivation of new ideas: The ideas generated after viewing the results of the information retrieved from the first search play an important part in defining or cultivating new ideas. In other words, what is perceived from readily available information contributes to the cultivation of new ideas.
c) Reduced idle time: Idle time matters for saving on wasted time and improving the search. Here perception is important. Although the initial delay time for the constructivist’s approach may be a few micro seconds more than the traditional search delay time, the overall time and efficiency in getting to the desired website may be less for the constructivist’s approach.

d) Learner-friendly and fun method: An individual’s perception of how much fun he had in retrieving the website or information can help in choosing which approach to follow. It is possible that learner-friendly approaches give a more positive result for a good perception.

2.1.2 Constructivist’s approach in insightful examination

Insightful examination is needed by evaluating several parameters that are related to the quality of data in terms of comprehensiveness, integrity, reliability, compliance to data formats, and precision and accuracy of data. Added to this is the fact that the nature of constructivism itself is such that any test conducted can be prone to subjectivity and website dependence. Also in question is the individual’s training to read fast on the screen.

2.1.3 Constructivism at the time of actual occurrence

These experiments should measure tangible happenings while retrieving information from the Internet. There are certain outcomes that are measurable by directly seeing the results of the comparison between the two approaches. The comparison can be made by
using traditional versus constructivist’s keywords. Outcomes are taken as facts for a particular kind of search. A higher probability of occurrence means a better chance of a particular feature to be the likely outcome. The measures of evaluation that can be considered are:

a. Repetition: By measuring the repetition of the same websites in a search, the number of occurrences specifies how redundant the retrieved material is and how much extra energy is being spent on retrieving repetitive information.

b. Reliance on real life examples versus reliance on theory: The number of websites retrieved which are more towards the real life example side of an explanation can be counted and contrasted against those that rely directly on theory. It has been found that in the case of the constructivist’s theory, the emphasis is more on the real life example side. Direct measurement of this aspect can be made by counting the websites.

c. Faster processing time for retrieval: The constructivist’s approach has a slower time for actual retrieval of websites in the initial search but it is only a few microseconds longer than the traditional process. Slow occurrence of the initial step is counteracted by faster retrieval times of higher orders when the websites are scanned for a better fit to the search criteria.

2.1.4 Constructivism during dynamic testing

Dynamic testing experiments are similar to conducting real life testing of parameters. Information retrieval can be performed by means of keyword selection and their results
can be compared for both the approaches. The correct conceptual perception followed by
dynamic testing allows scope for minimization of errors in a particular approach.
Retesting can be done if certain features have not been included in the testing criteria.
The important measures are:

a. Experience and flexibility of application: Experience and flexibility of application
    are dynamic phenomena and this aspect can be tested by conducting real life
    information retrieval tests. The learner’s experiences can be evaluated as to how
    easily a particular application contributes to the success of information retrieval.

b. Practicality: Dynamic testing is directly linked to practicality. The more practical
    a method is the more dynamic its outcome becomes. Both the constructivist and
    the traditional approaches can be compared for practicality.

c. Goal-directed searches: In order to measure the extent to which a search process is
    goal-directed or not, the same terminal website can be obtained with both the
    approaches (constructivist and the traditional) and then one can compare after
    how much effort (number of searches) the same website is finally retrieved.

2.2 Information overlap, subjectivity in decision making and speed reading

Before starting the evaluation experiments, the elements of website dependence
and subjectivity have to be understood. It will be unfair to compare the websites here
because the attempt is to consider the role of the combinations of conceptual perception,
insightful examination, dynamic testing and the actual occurrence (i.e. the transfer
process) on the given website and not to evaluate the website itself. The experiment has
to be performed by keeping the particular website as a reference base. It is only to be seen later if the same tests done on the two different websites give vastly different results in respect of the chosen attributes.

2.2.1 Extent of overlap and subjectivity

The constructivist’s theory focuses on the background and experience of the person concerned and hence his own choices to get results out of the retrieval process can be termed as subjective. In the first place, to minimize subjectivity, the chosen parameters need to be as crisp as possible so that the latitude in the interpretations is not large. Secondly, the precision of retrieval has to be judged. Precision can be defined by the ratio of the intersection of the absolute of the number of relevant documents with the number of retrieved documents to the number or absolute value of retrieved documents:

\[
\text{Precision} = \frac{|\{\text{relevant documents}\} \cap \{\text{retrieved documents}\}|}{|\{\text{retrieved documents}\}|}
\]

Precision helps to quantify the fraction of documents which are retrieved and are found to be relevant. The relevancy of each document is based upon preceding research and areas of study and hence the precision gradually increases at each step. There is a slight contradiction here. For the number of relevant documents to be more, the number
of retrieved documents needs to be high. But this is not necessarily so the other way round. Even if the number of relevant documents is stable, the number of retrieved documents can increase.

Overlap in the information retrieved is to be judged. There are two types of intersection possible between the number of relevant and retrieved documents.

(a) If the number of relevant documents (A) is a subset of the retrieved documents (B), then the intersection result (shaded area) which is (A) itself in this case on the numerator of the equation would be the number of relevant documents. This is given in Figure 2-2, in set theory where 'U' is the Universal set.

(b) If there are relevant articles found from another search and the total numbers of documents retrieved are counted as the retrieved documents, then only their intersection is counted as the relevant document number. This is given in Figure 2-3.

Figure 2-2 Overlap due to differences in the bulk of data.
In Figure 2-3, the small overlapping area (C) of ‘A’ and ‘B’ in the center are the relevant documents out of the whole. As the numerator increases or as the number of relevant documents increases, it is seen that the precision increases. The level of accuracy increases when precision is higher. Closeness to the original search is considered to be more accurate. It remains to be seen if, by applying the constructivist’s principle, the precision of the information search improves due to increase in the number of relevant documents.

2.2.2 Contribution of speed reading

Information retrieval involves a lot of reading to get the appropriate documents selected. If it is to be done manually, at least the decision making part, then the retrieval process would depend on the reading capacity of the individual. When there is a huge amount of data and the individual has a topic in mind for which he wants the most suitable material, a whole lot of dynamic selection and instantaneous discretion is
exercised to find the fitness of a material into the required criteria. Again, these choices vary from person to person and it may be difficult to get the same unified result all along.

The fact is that some speed reading techniques themselves are based on the constructivist’s theory. The single most important step is the reading of the material in the first stage (Shepherd & Unsworth-Mitchell, 1997). Data has to be recognized and this, as will be seen later, can be improved upon significantly by the constructivist’s theory. There has also to be an assimilation of the written material wherein the person understands what is being conveyed by the article. This encourages a deeper understanding of the subject while keeping one’s topic in mind. While looking for information, speed reading and constructivist’s thinking, together, encourage the most advantageous use of the brain power. This gives rise to better ways of creative thinking and considerable improvement in the correct sequence of thinking patterns.

In the following chapters, the advantages of using the constructivist’s theory for information retrieval based on keyword search criteria selection, speed reading techniques and mind maps will be revealed. It is to be seen if one gets more satisfaction by using the constructivist’s theory and gets the right material for the right person. Initially, this may seem too much of a task but once it is applied correctly it can be all the more fruitful. In the information grasping stage, also, constructivism can give rise to better retention, recollection and, finally, communication of the idea.
2.2.3 Scheme of presentation of the results of on-line experiments

From the above discussion, the idea of using the constructivist’s theory for information retrieval thus appears to be very challenging and interesting. The results of various on-line experiments conducted in this work are described in chapters 2-3. The logical sequence followed is conceptual perception, insightful examination, actual occurrence and, finally, dynamic testing. The experiments are descriptive because they elaborate and explain how constructivism enhances or ameliorates the content, quality and the speed of the information retrieved.
CHAPTER 3
CONSTRUCTIVISM IN CONCEPTUAL PERCEPTION AND ITS IMPACT ON INFORMATION RETRIEVAL

3.1 Introduction

One of the key parameters of conceptual perception, as described in section 1.1.1, is keyword selection. There are two stages of search. In the first stage when one is trying to retrieve information out of the Internet, some “special words” associated with the topic, forming the basis of the “search criteria,” are needed. In the second stage and onwards, once the final list of websites is chosen, further exploration and evaluation of the searched sites is done.

The “special words,” summarized from the material, are also called “keywords.” As soon as they are read, they give an overall idea of what is to be retrieved. Not only in the initial search criteria, but throughout the material, if the keywords are chosen and matched against the initial criteria using the constructivist’s theory, then it would accelerate information retrieval faster. While this is being done, the correlating power of the brain improves significantly and hence it gives a faster response to the search. One can simply see where the keywords to one’s thinking match rather than an automatic search where there is a literal mapping of words. The learner gets an opportunity to choose keywords by himself based on his experience and thus gets a more desirable outcome for the keyword search. It gives us the advantage of processing a lot of information at the same time. In short, in the constructivist’s approach, the divergent
correlations between different kinds of information are logically processed during the thought process and as a result the constructivist’s learner gets to choose what is to be the likely required information. (Shepherd & Unsworth-Mitchell, 1997). The major steps to information retrieval then become: searching for the right material, sorting them out according to their criteria, making an apt selection, and finally synthesizing the material, side by side. It also gives the reader a chance to make an original contribution to the topic and also learn from it while retrieving information using keywords.

The other aspects directly related to conceptual perception, as outlined in section 2.1.1, are cultivation of new ideas, reduced idle time, and a learner-friendly and fun method. The experiments to test the usefulness of constructivism in improving conceptual perception and hence keyword selection are discussed first, followed by the experiments conducted to identify the influence of constructivism.

3.2 Technique of keyword selection

The challenge here is to come up with a few specific words that can describe a whole lot of data. According to the constructivist’s approach, the learner first assembles all the prior ideas which might come into play using prior experience on the topic. Keywords can be a mix of different topics or could be an elaboration of the same topic. Keeping all the factors in mind, the retriever first constructs a holistic view of what is to be sought. This process of reflection deepens the reader’s understanding of the question in mind. There are many keys to this. During the process of selecting keywords, the retriever is faced with the information actively. If the constructivist’s theory is applied to
its most useful form, the retriever becomes conscious of the ideas conveyed by the keywords and gets more help by creating images and relations between them. It is known that mental images are better for reminding the mind the relations with the particular keyword. They are an easy way to remember the background of data. It would be easier if the words themselves are explicit. They should try to sum up the meaning of the whole data to be sought. It is this process that speeds up the useful information-seeking goal. This is because the further searches, if based on the correct keyword to start with, are simplified and yield better results. As the websites are linked within each other during the searches, choosing the correct keyword initially makes the problem much easier.

The keywords are important, but so also are images, graphs and drawings but they cannot be entered as search criteria. However, if the search is performed on an image site, say www.images.google.com, then the initial search still uses keywords and just by initially looking at the pictures the sites are refined and linked to others that relate to the same concept. So the constructivist’s theory can help even if the sites to be searched are linked by images or have images based on the same concept.

The constructivist’s approach increases the learner’s memory along with increasing relations with newer concepts pertaining to the subject. Since there is more participation of the learner with the data selected, it gives rise to newer thoughts on the topic. Free thinking is encouraged as a result of this. In short, keywords give rise to mental models which help frame up the base for further studies and also simultaneously sharpen the memory. Thus, there is a high level of concentration on the topic coming into play in order to get closer and closer to the topic which makes the whole information
retrieval process sharper and more accurate. The mental model forms a superb crossover point joining the most recent thought processes of the brain and the chosen keyword.

The help from the above way of making a mental model from the keywords is that it enhances the ability to picture information in a short step. Instead of imagining all data in one go and trying to analyze and come up with a short term for it, a quick image of the whole data read is kept in the mind in a very neat way. This picture of the mind is often more lasting than the pages of words talking on the same topic. There is always a better way of letting information stay in the mind in an effective manner and this is what helps to speed up the information retrieval process by narrowing down to words that can help search the topic faster and make them more towards the point.

Keyword selection is a part of the traditional approach to information retrieval as well, but the approach of the constructivist’s thinker is different. As discussed above, there is more involvement with the topic to narrow it down to make it the most accurate search. Since the knower about the topic here is the learner himself, memory is also sharpened when words parallel mental images and experiences of the learner also come in to play. The experiments to prove this aspect are described later in section 3.2.1.

3.2.1 Processing the information retrieved through speed reading

The keywords put in the search criteria give many results. Now, moving on to the next stage of actually reading the different sites retrieved, a whole list of websites containing the same or different order of words is presented. The initial search can help narrow down future searches. A topic may be broad enough that it cannot be defined by a
few words so it needs further definition and that is the function of further searches too. So a collection of facts from the initial search is important. A summary of a long paper, in one case, may be sufficient to judge whether it falls in the required criteria or not. Reading and that too intelligently, to just get a hold of what is being said in a summary is beneficial. This process differs widely from person to person as reading styles differ. Although this step may be overlooked, many-a-times this is where one can get critical information hidden within a document just because it was left unread. As can be seen, the reading style matters a lot here and a few seconds of scanned reading can affect the output. One may end up reading pages of the wrong kind of information just because a few minutes were not given to website choosing due to an unfocused reading style. A direct relationship between applying the constructivist’s theory in information retrieval and being able to read speedily is apparent. The faster one can read the relevant information, the faster is the retrieval process, at least as a preliminary step.

3.2.2 Constructivism in selection of websites

On the Internet, information is presented in the form of websites in an orderly manner after the keyword is typed into search criteria. Websites are listed after the search with headings of probable match with the subject presented by the keywords. This is where the real challenge of information retrieval comes into play. Some of the important criteria are based very much on the constructivist’s approach, for instance, being able to use one’s discretion in selecting the corresponding sites, choosing the right collection of sites initially which seem to fit into the category pointed out by keywords, combining
sites with partial or whole material relating to the search criteria and being able to read the documents for their important points at a reasonable speed. Although the initial step of recognizing which websites may be of use to the search may not take a long time, but it is this step which is often taken lightly in order to get to the main material within the sites. In information retrieval, this step is very crucial. The main sites which are chosen to be used for further reading are a key in deciding the elimination of other sites. Thus, a complementary relation is seen between that of the chosen sites which match the criterion and those which are rejected based on the same criterion. If the ratio between the two is defined by number of useful searches, the simple formula which needs to be at a maximum would be:

\[
\text{Selectivity of initial website search} = \frac{\text{Number of websites selected}}{\text{Number of websites rejected}}
\]

In order for the selectivity of the initial website search to be as high as possible (to make the efficiency of the retrieval process high), the ratio has to be increased by making the number of sites selected very high in comparison to the number of sites rejected. This brings the question of how to maintain a high ratio.

Simply reading a document at a faster speed would not resolve the problem single-handedly. A website may be read at a fast speed but that does not necessarily mean
that the grasping power of the site’s material would increase. A knowing effort has to be put in this process in order to get the optimal results. In fact, in the extreme case, reading a file or document at too fast a speed to relate with the original search can often skip over useful points. So, speed reading needs to be used in such a way that is to the advantage of the information retrieval process. In this step, the major process of retrieval gets decided. If a document is left out at this stage it does not have further scope of being useful since it did not qualify in the first stage at all. This is where a constructivist’s approach to the problem can again come to the rescue.

The constructivist’s theory keeps certain points in mind while practicing speed reading for the information retrieval process. As pointed out earlier, it improves the information retrieval process from the Internet by increasing selectivity and allowing a fast reading of documents before accepting or rejecting them. This, in turn, increases the number of useful documents retrieved and greatly improves the quality of the information retrieval process.

The constructivist’s approach is more interactive with the material. Thought is given to what all data can fit the search criteria in even the remotest way. This builds up a good knowledge base out of the data retrieved. Even seemingly unimportant sites may contain material that is very precise, to the point, and could be of great use to the retriever. Sometimes, it is these small points which trigger new ideas and are critical in further research. By keeping a background of the ideas in mind while reading, the whole context of the material is brought out in an effective way. The constructivist’s theory
focuses on the background, experience, interaction with the material and the retriever’s own choices before getting results out of the retrieval process.

Inspired and original thinking is a direct result of this as the retriever’s interest and inner thoughts are involved with the topic. Instead of a simple search using only words, there is scope for better ideas which come out as a conclusion to the entire thinking process. It can clearly be seen how this is leading to an increased ingenuity in the retrieval process with simple ideas that are being built upon.

The thinking procedure, initiated as a consequence of this application of the constructivist’s theory, gives rise to better results in further searches because the subsequent searches are linked to the main search. Constructivism is known to be an excellent tool for analyzing the meaning of the information retrieved (Warrick, 2007) and this is what is required during the manual information retrieval processes. Often, there is a whole new story generated out of the search by reading different ideas collectively. It is one of the advantages of the constructivist’s theory that original thinking is valued and research is on the cutting edge rather than simply improving on facts of previous results available on the Internet. Both the level of the search and that of the research following it are enhanced by following simple procedures in the constructivist’s theory. To illustrate the above point of views, it would be appropriate to show an example at this stage.

3.2.3 Examples of keyword selection through traditional and constructivist’s approaches

The advantages of following the constructivist’s approach in information retrieval can be seen against that of the traditional approach by an example where the idea is to
choose a university according to one’s choice. This is an easy choice if the decisions have already been taken by the retriever but may vary a lot according to the information gathered if there is a choice to be made based on the selection criteria. To explore the two cases, suppose the traditional way is followed. The first step is that of choosing the desired colleges out of the suitable list. The traditional way would be to enter the top, say, twenty to fifty colleges in a particular course. For a choice of engineering it would yield several results. On the other hand, if the constructivist’s approach is followed, the initial choice of engineering would matter, but a narrower subject would be put in the search criteria along with the other keywords related to engineering. In short:

Traditional approach keywords: Top 50 engineering colleges

Constructivist’s approach keywords: Excelling environmental colleges

Finding good ranking colleges is a part of the traditional approach whereas finding colleges that are good in a particular field of research is the constructivist’s approach. The “Excelling” keyword provides a scope for outstanding research in a particular area of study. Also, the word “engineering” is more general in the traditional case and not applied in “environmental” in the constructivist’s case.

Let us see the advantages here. First, there are fewer numbers of keywords in the constructivist’s way in spite of being more precise. The traditional approach may come up with a list of the top 50 colleges with a good engineering department. However, this will require that the reader look at each and every site and choose a secondary list out of the fifty colleges to narrow down to his choice. This gives rise to redundant choices
which could have been avoided in the first stage. Lots of confusing material and options deviate one from the search in the traditional case. As a contrast, in the second approach, the appropriate keywords have been chosen. The first keyword, ‘excelling’ cuts out the possibility of inferior colleges and can also include those colleges that may be beyond the first fifty ranks but have been well acclaimed for their research. The choices are clearer. The second keyword specifies which kind of engineering college is to be searched rather than all engineering colleges which eliminates all other colleges not related to the search. Also, here the ambiguity of the environmental engineering colleges is set aside by specifying it by its name as it could be a part of the civil engineering department, natural resources or science department. Some options for the environmental engineering department are given below:

http://www.cee.engineering.uiowa.edu/  Dept. of Civil and Environmental Engineering

http://www.cnr.usu.edu/envs/  Dept. of Environment and Society, College of Natural Resources

http://envsci.rutgers.edu/site/index.shtml  Dept. of Environmental Sciences

http://hort.ifas.ufl.edu/  Environmental Horticulture Dept, Dept of Agriculture

http://www.ced.berkeley.edu/  College of Environmental Design

http://www.eh.uc.edu/  Dept. of Environmental Health, College of Medicine
While the list is lengthy, the colleges chosen portray how many related sites a single keyword can help bring forward. If one is presented with these choices, it would be certainly easier to come to a meaningful understanding as to which college suits one's needs in the best possible way. This method would make it faster to get to the real topic without wasting time looking for departments which might not be even there in some colleges.

Traditional versus constructivist search test on www.google.com is conducted as follows. Taking the constructivist and the traditional approaches side-by-side, suppose the keywords are chosen as follows:

Traditional approach keywords: Top 50 engineering colleges

Constructivist’s approach keywords: Excelling environmental colleges

When these are put in the search criteria on www.google.com the results are as follows:

The first (traditional) search would give: 19,800,000 results

The second (constructivist) search would give 268,000 results

As can be seen, a lot of redundancy has been reduced by a number of (19800000-268000) or 19,532,000 sites. Further search is not required on these extra sites in the case of the constructivist’s approach. The discussions follow the screen shots and the traditional search results are described in Figure 3-1.
Though it may apparently seem that getting more sites for a search is beneficial, the number of websites does not come in handy if they do not correspond to the user’s requirement. The above websites search has an overabundance of 1953200 sites which is not beneficial. It does not save time and energy. Even the number of sites which are related to the search are probably not as useful and do not fall strictly into the word criteria. Since the numbers of keywords are more, the probability of retrieving the number of sites with that keyword increases but precision is lost. As by the precision formula the intersection of the retrieved and relevant documents is low, the overall precision level falls. The relevant material is less even though there are more sites to choose from.

Lots of retrieval examples can be given as to represent a proper method for getting information from the Internet. However, the basic way of the constructivist’s theory is to combine one’s own knowledge and experience gained on a subject. Examples of a typical constructivist search have been shown but it should be noted that these are not the only methods of retrieving information on a particular keyword search. The traditional approach, on the other hand is more typical in its ways to retrieve information. The keywords drive the main word search but in a different way. A reader would appreciate getting sites that are useful to him in place of thousands of more websites that would only confuse him. Thus, more information in the case of information retrieval matters but it must be relevant information else it would be plain and redundant data. Constructivist’s approach results are portrayed in Figure 3-2.
Figure 3-1 Screenshot of the traditional keyword search.
Figure 3-2 Screenshot of the constructivist’s search.

From the above website search for “excelling environmental colleges” the degree of relevancy is higher. As can be seen in the screenshot, the numbers of websites are 268,000; considerably lower than the previous search in the traditional way. The number of redundant sites has been automatically reduced by decreasing the unnecessary sites. Precision is thus increased since the intersection of the relevant and retrieved document increases. Just by a simple comparison in the number of websites retrieved gives an idea of how the constructivist’s approach can be faster. Lesser sites to read mean lesser evaluation of the content and hence speeding up of the process. Also, if the correct and
more closely related sites are listed then there is more focus on the topic at hand. Other sites do not divert the mind of the retriever from what is being searched and thus waste further time. Most important, since the major work of choosing the right websites has been done, research can be carried on reliably on those few websites. Thus the initial step of choosing the right keyword using the constructivist’s approach is helpful in information retrieval.

3.3 Cultivation of new ideas

One very positive advantage of using the constructivist’s theory for retrieving information is that new ideas are cultivated from existing information. Keeping experience and flexibility of application in mind, the interactive nature of this approach gives rise to developing new ideas through a right perception. Although new ideas can be generated in any environment, constructivism develops a good base for them to grow. These ideas are mainly fueled by readily available information on the Internet, the inquisitive nature of applying ideas, better websites retrieved and websites with better research material. Being able to analyze trends in a certain field helps the reader to get a stronger base and apply the knowledge gained to newer techniques. The retriever’s thoughts (or the process of perception) are deeply involved with the subject and reflect ingenuity in information retrieval rather than passively searching for information using the automated search. This encourages meaning-making which is a fundamental element of the constructivist’s theory.
A person’s intellectual abilities are greatly enhanced when there is information present that can be readily analyzed and used for gaining a better understanding of the subject. When the right kind of information is retrieved, it builds a path to generation of ideas quickly and efficiently. Being able to modify searches according to the keywords selected helps the retriever to go in the direction of research. If information is presented in an endless list of websites, getting new ideas out of it becomes a task. Let us study this aspect with an example.

Let the keywords for both the approaches be defined as:

Constructivist’s approach: environmental research colleges

Traditional approach: environmental science programs

Although the keywords seem to be essentially the same, they produce different results with the constructivist’s approach being more exacting in cultivating new ideas, as given in Figure 3-3 and Figure 3-2.

There is an option for special opportunities in Figure 3-3 giving a list of possible research opportunities in the field. These ideas are fuel for the mind to help discover new knowledge and research methods. In contrast, the traditional approach gives a broad list of colleges which might have research in the environmental engineering field. Initially, there are no options to find good colleges with the most up-to-date research. This is apparent in Figure 3-2.
Figure 3-3 Special opportunities listed for research in http://www.cofc.edu/academics/specialopportunities/index.php
This website was found to be better than the other websites for the search. However, it still did not match the intention for providing a base for cultivating new ideas. Further search options present within this site are based on campus and on-line searches and location in the United States. The chances of getting new ideas using this approach are less as there is not enough data available on the topic. New research opportunities are not mentioned and they are not available readily. One has to search for ideas within websites and then also there is no surety whether they are up-to-date or from colleges with good rankings. Alternatively, the constructivist’s approach gives rise to imaginative minds. Both discussions as well as being able to acquire knowledge on one’s own are encouraged. Since there is enough information to build an idea, just by grasping the right information, new ideas can be generated. The constructivist’s search thus provides a good base for new ideas to develop. Interacting with the websites and choosing keywords helps this process further.

3.4 Reduced idle time

Some information search processes flow smoothly but most of them involve a certain amount of time that is wasted while waiting for the correct website to come up. This is called idle time. Idle time also comes into play when time elapses during the time many sites are looked into by the reader before arriving at the desired site. There is less idle time for the learner while waiting to search for the correct sites if it is computerized. A small idle time indicates how quickly the desired information is available to the
retriever. Reduction in idle time helps to maintain concentration and hence continuity of thoughts (or of perception).

Figure 3-4  Traditional method with no research opportunities discussed from http://www.gradschools.com/Subject/Environmental-Science/151.html

In the constructivist’s approach, idle time is kept to a minimum. Since it is a faster and a more direct way of accessing information, idle time automatically gets reduced. Suppose the keywords used are as follows:

- Top environmental colleges  (Constructivist’s approach)
- Top engineering colleges  (Traditional approach)

The constructivist’s approach gives rise to 54,200,000 websites as given in Figure 3-3.
Comparing the two figures, it is clear that the constructivist’s approach gives a longer list of websites (54,200,000) circled in figure than the traditional approach with (12,500,000) as given in Figure 3-4. This number changes as searches are repeated and is not constant as the number of websites increases. A higher number of websites obtained from the initial search by the constructivist’s approach saves time for repeating the search with different keywords. A longer list may not necessarily mean a longer list of relevant websites but the probability to retrieve information certainly increases if there is a huge difference in their number (417,000,000).

Reduced idle times are shown in the website retrieval times starting from when the keywords are typed till the final website is obtained. In the constructivist’s case this timing differs as the user decides which website is supposed to be the main source of information. Slow occurrence of the initial delay time for the constructivist approach, therefore, includes other search times as well. Overall, the constructivist approach is faster and even while trying to retrieve the websites, the user is actively engaged in getting the final website. This is an additional advantage in terms of getting to learn more about the topic while searching for the main source of information. The traditional method is more mechanical and extensive as words are used for mapping information present in websites to the search criteria.
Here the initial number of websites obtained in the constructivist’s approach are fewer in number. This actually reduces a lot of searching through websites that are not related to the search criteria. Thus the constructivist’s approach turns out to be more specific. The initial choices themselves are modified to suit user requirements. Most of the websites retrieved may not reflect the search criteria, as it turns out to be the case in the traditional search. In this way time is saved. For this search, it is assumed that the top page list of websites has the most relevant material.
3.5 Learner-friendly and fun method

The constructivist’s method teaches the mind to grasp fast and leads to a sharper learning and application ability. It promotes an instantaneous application of the mind. Interaction with information is crucial in enabling a more learner-friendly way of carrying out a search. When the retriever gets ideas from the website in how to channel his search into a better direction, the process becomes less tiring and more helpful.

Although many parameters can be used to compare the two approaches, Table 4-1 compares the performance of the two approaches using three main criteria. The approaches have been compared for being fun, informative and learner-friendly.
Table 4-1

*Comparison Between the Two Approaches*

<table>
<thead>
<tr>
<th>Approach</th>
<th>Learner-friendly</th>
<th>Fun</th>
<th>Informative</th>
</tr>
</thead>
<tbody>
<tr>
<td>Traditional</td>
<td>After websites have been retrieved</td>
<td>Not much</td>
<td>Information available in huge chunks</td>
</tr>
<tr>
<td>Constructivist</td>
<td>Interactive right from the beginning and throughout</td>
<td>Quicker, easier, and enjoyable</td>
<td>More relevant and to the point</td>
</tr>
</tbody>
</table>

The “learner-friendly” aspect means that the user is benefited with proper information guidance right from the start of the search. Retrieving information then no longer becomes a huge task. This makes the constructivist’s approach more fun and informative.

In general, in the constructivist’s approach for search, the basic information is presented in an outline which is further explained by relevant facts. This is not the situation in the traditional approach. Lots of websites with similar words are captured in
one search, and often, the reader has to go through them reading the same information in common to most of the websites before he come arrive at something concrete. Since words are the main criteria which describe the idea and not the idea itself, the websites retrieved are not quite in line with the idea. It may be said that words or combinations of them describe an idea but the fundamental difference lies in presenting an idea in words. For example, ‘air pollution research’ from the constructivist’s viewpoint gives an idea that research on air pollution specifically is the required criteria. From the traditional approach, similar words such as ‘air pollution statistics’ may not convey the idea that research on the air pollution area is in focus. Though these keywords may seem more focused in getting the statistical content related to a particular research, statistics are only part of the research and data on other experimental causes and phenomenon is absent from the retrieved information list.

For this, let us take an interesting example where images are the main source of primary information about a website. If only www.google.com was to be referenced in place of www.images.google.com, the search process path would be different as the data would rely on printed information. However, when images are the primary source, the method becomes more learner-friendly and fun. To keep the basis of comparison the same, the images method is used below for both the approaches. The reason of keeping the same procedure initially is to give a direct contrast in how the constructivist’s method can outperform the traditional approach.
3.5.1 Learner-friendly and fun method: experiment 1

Based on the keywords used throughout, let us take topics for keywords which sound very similar but give different results. Hence, a more apt comparison can be made between the two methods and the salient points can be observed.

Constructivist’s keyword: environmental research

Traditional keyword: environmental issue

Both keywords essentially are connected to the environmental field. One is concerned with its research aspect whereas the other is concerned with issues. The constructivist’s keywords focus on finding research on environmental issues whereas the traditional keywords emphasize the issues themselves. It may be so that one search method leads to the other, the point here is to note how keywords are influenced by the method of retrieval. The constructivist’s search has its first ten website options as given in Figure 3-7 and the traditional search results are presented in Figure 3-6.

The constructivist’s approach gives websites that are more focused on the research topic. Instead of seeing pictures symbolizing environmental research, it is fun to see a picture of people out there in the river trying to do research, Figure 2-9. This is the first website referred.

In order to call a particular approach learner-friendly, mostly ease of use of the retriever and his individual perception of an idea has been taken into account. The constructivist’s approach has an edge over the traditional approach as using one’s experience and being able to interact with the search process makes the process of retrieval much easier.
Figure 3-7 Results for the constructivist’s search, top 10 website list and options.

The traditional website on an environmental issue gives a picture, Figure 3-10, which does not immediately refer to an air pollution problem. Since it is a black and white image, it may initially give the impression of a foggy day on a city. Even if it is certain that there is excessive air pollution in the city, it does not directly refer to a website on an “environmental issue.” It has the title “Area” which does not imply the keywords “environmental issue”. The constructivist’s image is more apt and involves one to know more on the subject. It clearly depicts a research going on in the picture. On further seeing the websites that both the keywords suggest, it is clear that it is a National research park which is given in Figure 3-11.
Figure 3-8 Traditional search results with top 10 website list and options taken from www.images.google.com

Figure 3-9 On-going research: depiction through constructivist’s approach www.esd.ornl.gov/facilities/nerp/
Figure 3-10 Depiction through traditional approach from sitemaker.umich.edu/section4group1/fossil_fuels

Figure 3-11 Constructivist search results on environmental research from: www.esd.ornl.gov/facilities/nerp/
From the website page given, there is a whole National Research Park dedicated to environmental research. The website retrieval process is fun as the very first website leads to the desired results. The initial image leading to this website is also fascinating as it helps the retriever to guess out a solution to the query put in the form of a keyword. This is an overall learner-friendly process as it takes less time, is easy to follow and fast to get to the desired website; images describe the website adequately and finally this leads to an informative site with the required data.

In contrast to the easy and learner-friendly approach, the traditional approach is not all that fun. Here is how the website represents, Figure 3-12, the keyword “environmental issues.”

Figure 3-12 Traditional approach on ‘environmental issue’ from http://sitemaker.umich.edu/section4group1/fossil_fuels
The traditional keywords deviate from the main point on finding an environmental research website. Only one of the issues is given here on fossil fuels and that too from an investment perspective. The original image with the heading “Area” was neither linked to air pollution as an issue nor an investment topic on fossil fuels. Getting to the main issue follows a very indirect procedure of looking through and screening many websites before the apt website can be reached.

The overall process for retrieving information using the traditional search method is not that learner-friendly. First of all, the desired information is not reached quickly. The website deviates from the intended search. Second, the information present in the images does not completely symbolize the website search. This technique is not all that fun as the images do not convey what the underlying material may be. Starting with an “environmental issue” as the keyword, and then selecting an image showing air pollution leads to a website on investment on fossil fuels, which is a difficult and unexciting way.

3.5.2 Learner-friendly and fun method: experiment 2

The results on the website for fossil fuels are one aspect of a possible environmental research problem. But there lies a difference in being able to identify an issue and carrying out research on it. This means that the keywords and the original image were not true representatives of the idea to be searched. It could be possible that after subsequent searches on the same images page, other websites could lead to better options. Let us take another image to see how closely it corresponds to the main search
criterion. From the website list, the next website shows a similar picture of a city depicting air pollution, so let us analyze the next website in Figure 3-11.

Figure 3-13 seems fascinating for some kind of environmental research on global warming as depicted by the main image on “melting ice.” A lot of factors are involved in global warming caused by natural and man-made reasons of polluting the environment. This suggests a tentative good website for research on the issue of global warming. Let’s see how close our prediction is to the actual website content.

![Melting Ice](http://environment.airports.com.mv/images/meltingice1.jpg)

*Figure 3-13 “Melting ice” showing an environmental issue from http://environment.airports.com.mv/images/meltingice1.jpg*

There is an emphasis on showing the issues in concern of today’s world. As circled in Figure 3-14, the main issue is protecting the environment from an issue on the world environment day. Also, the emphasis is more to encourage protection of the environment. No particular research area has been focused on. This is also apparent on the other aspect on animal protection of the website clip is given Figure 3-13.
From Figure 3-15 it is clear that although the issues have been identified well, not much explanation and research on the subject has been performed. It is now clear that even if the words “environmental” and “issue” are meant to convey the same idea from the keywords, choosing the right keywords always has an edge over choosing a keyword which just about conveys the same idea. The constructivist’s keywords are better in giving concrete research which revolves around environmental issues. Thus, the constructivist’s approach is inclusive of the traditional approach keywords.

Figure 3-14 Protection of the environment in the traditional approach from http://environment.airports.com.mv/index.htm

“Language communications and cognition” as applied to information retrieval is a deep area of studies these days (Boland, & Tenkasi, 1995). According to
them, “the computer happens to be supplementing for the information processing mode with a narrative mode of cognition present in our minds.”

![Protection of Animals](http://environment.airports.com.mv/index.htm)

Another important question related to the environment is the good treatment of the animals in our lives, and the protection of them; or more correctly, extending our kindness and compassion to them.

*Figure 3-15 Environmental issues in the traditional approach*


This is apparent in the preceding example where keywords describe and communicate the language of the mind. As discussed in the literature review, constructivism does have many of its roots in psychology. The way in which the mind consolidates all information and gets a meaning out of the whole perspective is what decides the search. Reducing noise in the communication channel would mean the same as eliminating words that are not relevant to the topic or may introduce more noise than useful thoughts. It is these words that have helped the constructivist’s search in the
previous example leading to direct and informative websites on environmental research. The traditional method was effective to a certain point in being able to describe the issues related to the search but the keywords were not directed wholly to the main idea in mind. These are ‘assumptions’ the mind makes while trying to put ideas into practice.

The psychology of the learner plays a decisive role in information retrieval. The constructivist retriever keeps a better track of the subject in mind by letting his interaction and experience with the search topic drive the search. Prior learning is given importance. The learner gets a chance to “construct” the meaning of the topic when the keyword search option is before him. Instead of giving it a topic, he gives it an idea. That is what makes the constructivist’s information retrieval process different from the traditional search process. This makes the process fun and not just an endless search. As seen with the image search example, information retrieval becomes more rewarding when images are to be chosen as potential indicators of knowledge stored in their respective websites. Information is present readily and in abundance on the very topic that was being searched for.

In the traditional search, since there is not much thought given to the subject initially, the process takes time to gather meanings from the information gathered from data from different websites. This leads to a series of repeated searches before the desired websites seem near. The search process is more of a continuing website search where one search is driven by the information present in the preceding website. Possibilities are limited to words in the keyword or image criteria in the traditional search. This eventually has a constraint on what an idea may convey. For example, “environmental
issues” are a part of research, but the keywords take it literally in describing only issues that may be concerned with the environmental problem; thus leaving the research part to not have its full probable description.
4.1 Introduction

The key parameters of insightful examination, as described in section 2.1.2, are data quality, learner’s discretion, and acquiring information within a website. It is interesting to study the influence of constructivism on these parameters.

4.2 Improvement in the quality of retrieved data

Information retrieved should have a high data quality else it is not useful to the retriever. The number of websites retrieved is one aspect but there are additional factors which define data quality. Once the initial search has been carried out, and redundant websites have been ruled out, measuring data quality becomes essential to make a meaningful comparison between the constructivist and traditional approach. Data quality has many dimensions like comprehensiveness, integrity, reliability, compliance to formats, precision and accuracy, and repetition. Each of the dimensions of data quality retrieved can be examined, one-by-one, by using the same example of university selection for the Environmental Engineering field. The website chosen for this purpose is http://www.melissadata.com/enews/articles/1007/2.htm.

4.2.1 Comprehensiveness of data retrieved

The depth of material covered is important in the retrieved documents. Data quality
increases when the information is more complete without any data absent. Even if a certain amount of information is found to be absent, one can ask if it affects the overall search.

Data retrieved may be presented in two different forms in the constructivists versus traditional approach but data quality is judged based on their comprehensiveness with respect to the main search and the number of points covered (which provide more information on the related search). Let us see this aspect by an example. In the first search (the traditional search) the keywords “Top 50 engineering colleges” were chosen as against the constructivist’s search of “Excelling environmental colleges.” Whereas the first strategy would give a more complete list for engineering colleges, the search list would be more complete with names of excelling engineering colleges. In one way, the traditional approach is more extensive but the constructivist’s approach is more focused and hence complete. Since the word “excelling” includes the top 50 colleges, even though the list may seem lengthy for the traditional way, the cream of college lists is brought out in the constructivists’ way for environmental engineering specifically. To show this more clearly, let us choose the first website that is returned from each search. In the traditional approach, the first website http://www.graduateshotline.com/ranks/ gave a list of top 55 colleges as given in Figure 4-1.

This example shows how a slight difference in keywords creates a whole different final website from the search criteria. Being exact in keywords is the nature of the constructivist’s approach whereas being extensive in covering a subject with keywords is the main way of the traditional approach.
Figure 4-1 Screenshot of the traditional approach from http://www.graduateshotline.com/ranks/

Using the constructivist’s approach, as given in Figure 4-2, there are roughly 18 environmental colleges listed. This is not just a list but many of them were explained as to why they were excelling.

There is also a small box that can help the retriever to select which subject within environmental engineering can be of use to the retriever. This additional search box, Figure 4-3, is an added advantage to the constructivist’s approach of comprehensiveness and completeness in a search.
Figure 4-2 Website search result based on the constructivist’s approach from http://education-portal.com/environmental_colleges.html

Three choices of ‘Forestry,’ ‘Natural Resources Conservation,’ and ‘Wildlife and Wild Lands Science and Management,’ are given. The Degree level and choices of States for engineering colleges are given. This provides a more rigid structure for search and even though a top 50 list is not presented it is more specific and easier for the retriever to put in choices and get results according to his search criteria. In this way, the
constructivist’s method turns out to be more complete even though initially it may seem to have a lesser number of listings of engineering colleges in them.

![Image of search for degrees, careers, and schools](image-url)

*Figure 4-3* Subject specific options within the environmental engineering option from the website: [http://education-portal.com/environmental_colleges.html](http://education-portal.com/environmental_colleges.html)

4.2.2 Integrity of data retrieved

The next major dimension to measure data quality is integrity. Integrity of data quality involves no gaps in understanding the data. The data presented must be well integrated in the sense that it must be linked well in the information retrieved. This reduces repetition in documents. This has already been given as a benefit in the constructivist’s approach because there are too many websites listed in the initial search in the traditional approach. In the “excelling environmental colleges” search, (section 4.2.1), there are fewer websites but they are more subject specific, covering all the areas of study for environmental engineering. The information provided is linked as every college has details of what is being offered in the program. Thus, the retriever can understand the links and opt for colleges which suite his needs. Even though the keyword
“engineering” is missing in the constructivist’s approach, it actually helped in finding colleges related to the environmental department instead of the engineering aspect of it. The more the data is organized, it increases integrity.

4.2.3 Reliability of data retrieved

Another well known dimension for quality of data is the reliability of the data. This is concerned with different websites providing contradictory information about the same data. The data cannot be reliable if many versions of the information are provided for the same keyword. Also, the specific characteristics need to be consistent within the various data sets obtained. The inter-reliant variables should be indicative of the evenness in data. The problem of reliability is more evident when many systems are brought on to the same platform for comparison. Here, in our examples also [section 4.2.1], similar kinds of search is conducted with the singular intent of finding good environmental engineering related colleges.

In the traditional approach, the list provided in the first website is not so reliable as it changes from time to time and from one website to another. The top 5 recommended colleges with totally different rankings can be seen. For example, MIT which has the highest ranking in the first website is replaced by a lesser known Colgate University. The list taken from the website:

http://www.studentsreview.com/top_engineering_schools_ranking.html and is given with different rankings and lesser reliability and consistency.
In the constructivist’s approach, the next informative website still gives a list of better environmental engineering schools like Yale University. The option of choosing within the environmental engineering field is present in a box where the required area of study along with the State and Degree is there just as in the case of the first website. It implies that the same method is being followed throughout for retrieving colleges of one’s preference in the constructivist’s approach. This makes it more reliable as matching data is corresponding in search from one website to another. In the traditional way, there were huge gaps in understanding when the search was based on a list of websites alone.

As an example of the more reliable constructivist’s approach, a search box is present in Figure 4-4.

![EnviroEducation.com](http://www.enviroeducation.com/)

*Figure 4-4* Similar results for subject search in the constructivist’s approach from http://www.enviroeducation.com/
In the traditional approach, Figure 4-5, there is no such choice available. A list of top colleges is the only guide to find a suitable college. Since the environmental field has many fields within it, wrong results could be obtained if the subfields are not clearly mentioned. Also, in the ranking list, there is no clear explanation as to why one college is better than the other.

Figure 4-5 Data retrieved using the traditional approach with differing rankings from the website [http://www.studentsreview.com/top_engineering_schools_ranking.html](http://www.studentsreview.com/top_engineering_schools_ranking.html)
4.2.4 Compliance to formats

In the search for specific data, besides integrity and reliability, the compliance to formats is equally important. If a search is carried out for a list of engineering colleges, then other lists even if related closely to engineering should be in a different format. Once that is ascertained, all variables should follow the same configuration. This dimension helps a lot in characterizing data, searching and setting up associations among interrelated data. In our example, there is a high degree of compliance to formats in the constructivist’s case. Both the websites, within the first search, contained a search box, Figure 4-3, for a narrower search. The format for finding a particular environmental field college was the same. Once the links of colleges were clicked in the second website, it gave a similar outline of colleges according to their degree as in the first one. However, in the traditional method, Figure 4-5, the first two websites differed in their approach to get a list of top colleges. Although they were searching for the same material, the top 5 ranks of colleges differed completely. In the second search, colleges were evaluated on a score basis taken out of surveys whereas the first website had only a listing available without a survey.

4.2.5 Precision and accuracy of data

In relation to data quality, precision and accuracy mean a measure which determines how close the data retrieved is to the actual word. The data is all assembled to give a representation of the world with which it should match. Wrong data and information availability at an inappropriate timing can affect the accuracy of data because
it is further used when it is retrieved. That is why the “recent results” option in the www.google.com is very helpful for increasing accuracy and precision. Logical applications of data help in increasing the accuracy of the information retrieved. In the example taken, the constructivist’s approach leads to an area-specific selection of colleges for different states and degrees. There is also a short video describing what fields are present in environmental management, while describing its subparts as given in Figure 4-4. Videos are actually a good way of conveying information in a fast manner to the retriever. A lot of condensed information is present in a video where the most important points are highlighted. This definitely saves time and energy of the retriever while trying to find out if there is any relevant information present in the website. The video gives a positive advertisement of the website.

Figure 4-6 Video clip explaining environmental management in the website:
http://education-portal.com/environmental_colleges.html
Each university presents a short summary of its program, thereby helping the retriever to get most out of the initial search. For the traditional approach, there is no basis for the top 50 listing. Also, there are no links to the universities themselves as it is just a list of rankings. In the “excelling environmental colleges” websites, the most prestigious colleges are described as given in the Figure 4-5.

*Figure 4-7 Description of colleges in the constructivist’s approach from the website http://education-portal.com/environmental_colleges.html*
CHAPTER 5
CONSTRUCTIVIST METHOD IN ANALYSIS OF ACTUAL OCCURRENCE DURING INFORMATION RETRIEVAL

5.1 Introduction

As mentioned in section 2.1.3, this aspect measures the tangible happenings while retrieving information from the Internet. The measures include repetition of data, the extent of reliance on real life examples versus reliance on theory, and the overall processing time for retrieval.

5.2 Repetition of data

Similar data on the same topic is often redundant. In information retrieval, where the quality and not the quantity of data is considered to be more important, repetition is not a welcome event to be found in websites. Taking our example of the top 50 engineering colleges, we can see that there is more probability of repetition of websites. Many websites would give the same results within the 50 colleges range with some reshuffling. This increases redundant data as there are multiple versions of the same data. If there are too many forms of the same information set gathered then it becomes hard to find out which is the actual form. Validity of data comes into question as it is not reproducible to give the same results. For the traditional approach, there is a wide list of top 50 engineering colleges, each with a different ranking. For instance these two clips, Figure 5-1 and Figure 5-2, taken for the top 12 colleges out of the 50, look similar.
Even if there is a repetition in the websites, it should follow a consistent pattern.

Data redundancy should be kept at a minimum. In the example given, the same college rankings are not present consistently in different websites. There is a major difference in listing even the top ten to twenty rankings. The constructivist approach, on the other hand, removes this redundancy by giving data that is more exact and hence precise in nature. A lot of information can often be difficult to understand if it is not consistent.
Figure 5-2: Top 50 university list

One aspect of quality is ease of use and sustainability. It is concerned with the degree to which the data are recent and can be used. If the data is ready at hand, it means that even in further searches, after a lapse of time, the results will not vary. The data contained is sustainable over time and does not vary drastically.
From the first search, a good website which is known to provide good rankings is chosen. This is a website showing rankings. However, first a choice has to be made between departments and then this page is referenced increasing idle time.

These are environmental engineering schools specifically. It gives a list of the top schools as given in Figure 5-1.

*Figure 5-3 List of top environmental colleges for 2005; traditional approach from [http://grad-schools.usnews.rankingsandreviews.com/best-graduate-schools/top-engineering-schools/environmental-engineering](http://grad-schools.usnews.rankingsandreviews.com/best-graduate-schools/top-engineering-schools/environmental-engineering).*
For the year 2009, keeping all other conditions the same, the results are as follows for engineering taken from the same website. The screenshot of rankings is given in Figure 5-2.

![Table of rankings](http://grad-schools.usnews.rankingsandreviews.com/best-graduate-schools/top-engineering-schools/rankings)

*Figure 5-4 Top university list for engineering from http://grad-schools.usnews.rankingsandreviews.com/best-graduate-schools/top-engineering-schools/rankings*

As we can see from the rankings in the Figure 5-4, even the top five rankings do not match. Simply by changing the keyword from environmental to engineering makes a huge difference and data is not easy to compare. The rankings are mixed-up and are not
valid within the same time frame of year 2009. On the other hand, let us take the same approach in the constructivist’s way. Here the keywords “excelling environmental colleges” are used which is very specific. Here the environmental department does not have to compete with other engineering fields for a rank. Instead, it simply gives a college listing according to area of study. There is less reliance on ranks which do not have a proper basis and more reliance on the actual subject and its subdivisions. There is no chance of variations as the specifications are more exact. Comparing data, therefore, becomes easier and the websites become easy to use in the constructivist’s way.

5.3 More reliance on real life examples and less reliance on theory

The constructivist’s approach relies more on real life examples. This is evident from the fact that while actually using the Internet the constructivist’s uses his past experience and daily life examples rather than relying on traditional theoretical methods. Since the constructivist retriever believes that knowledge can be created within one’s own self so there is a lot of reliance on what is happening in the real world rather than falling back on old theoretical methods. The traditional retriever believes that information is external to the user and it needs to be acquired. Thus there is always a huge amount of data in the latter method. Putting real life examples into use is a more practical method as it includes all recent developments in the field. The retriever has a say in choosing which information would fit his background of knowledge and proceed accordingly. This makes the constructivist’s approach easy to use and apply. Keeping a track of one’s own experience is a natural phenomenon and being able to apply it in information retrieval is
not all that difficult as in the traditional search process gaining knowledge starts from scrap. Let us take an example to show this aspect where in one search there is some expertise already present in the environmental engineering field compared to the other search. By his past experience the constructivist inserts the keyword: ‘air pollution research + colleges’. The traditional search keyword is: ‘environmental research colleges’ with results in Figure 5-3.

![Initial website for comparison between the two approaches](http://www.erg.kcl.ac.uk/Modelling.aspx?DeptID=Modelling)

*Figure 5-5 Initial website for comparison between the two approaches from http://www.erg.kcl.ac.uk/Modelling.aspx?DeptID=Modelling*

Because of his specialization in the particular field of air pollution, the retriever knows which processes are in use. In Figure 5-6, the modeling aspect has been elaborated upon. Air pollution toxicity can be easily studied as it is listed in the main search criteria.
on the website. The emissions and monitoring aspects can be easily accessed. Real life examples give ideas for research in lung biology as they can cause harm. The “London air pollution toolkit” in the website gives an example that has already been implemented for modeling and measuring emission quality.

![Environmental Research Group](http://www.erg.kcl.ac.uk/Modelling.aspx?DeptID=Modelling&CategoryID=ModellingDevelopment)

*Figure 5-6* Real life example in air pollution with model development from [http://www.erg.kcl.ac.uk/Modelling.aspx?DeptID=Modelling&CategoryID=ModellingDevelopment](http://www.erg.kcl.ac.uk/Modelling.aspx?DeptID=Modelling&CategoryID=ModellingDevelopment)

The above model is a real life implementation of estimating low emission zones in London and has also been used in health research. Since these ideas have already been put to use in the real world, knowledge gained from such websites can be regarded to be more authentic than the traditional approach. Theory behind the search has already been put into its practical application. This feature is more prominent in Figure 5-7 where a
column named “Applications” is specially allocated to such kind of research. Emissions based congestion charging is being studied in the London low emission zone. As seen in Figure 5-7, there are other categories for model development and road traffic emissions as well. Overall, the constructivist’s approach gives rise to information which is more practical, easily applicable and based on current ongoing research.

Figure 5-7 Demonstration of the real life application in the constructivist’s approach from http://www.erg.kcl.ac.uk/Modelling.aspx?DeptID=Modelling&CategoryID=ModellingApplications

In contrast to this, the insertion of the keywords “environmental research colleges” gives rise to Figure 5-6. The traditional approach gives a broad outline of the topic without any focus on the subject. Options for different fields are there but getting to the air pollution modeling topic would be tougher compared to the constructivist’s approach if there is no real life experience for the retriever. Choosing from a list of
options becomes harder if there is no prior knowledge about the subject. It is not easy to use as there is no interaction of the search criteria with the retriever’s experience in the subject. In fact, many topics listed on the website could actually puzzle a first time learner. There is more reliance on theory to get to the actual topic which may be misleading as theoretical concepts are similar within a research topic; it makes it harder to search for one particular topic and gain knowledge from it. More knowledge can be gained if theory is put into practice. Having a strong theoretical base is always beneficial but practical aspects cover the underlying theory as well. The website, given in Figure 5-8, has many areas related to environmental science and programs but it does not have the required summary of research in the college which can actually provide useful data for research.

5.4 Faster processing time for retrieval

Time required between the start of the retrieval process by entering the typed keywords to the time when the retrieved information is collected is reduced by the constructivist’s approach. Idle time has already been compared in section 3.4 and found to be less in the constructivist’s search. Retrieval time is reduced because of the more focused, learner-oriented and exacting nature of the search where ideas are used to drive the search rather than words. It may be so that sometimes the first website page list may come up earlier for the traditional search but the time duration is usually within the 1 second range. These initial timings therefore are not as important as the sum of such
timings to get to the final website(s). Let us study the overall time required for each of
the approaches taking simple keywords for comparison.

Constructivist’s keywords: air pollution control + research

Traditional keywords: environmental pollution control

The keywords have been chosen to represent the same idea—that of finding ways
to reduce air pollution. In the constructivist’s condition, the keywords are area-specific
for air pollution. More research on controlling air pollution is the central idea of the
search. These keywords have kept the experience of the retriever in mind by specifying
the type of pollution and hence interacting with the search process to give related data.
The traditional approach, on the other hand, gives a more general suggestion of the topic
in focus. Environmental pollution encompasses air pollution. It may seem that this might
lead to more information on the subject but it would increase redundancy.

The initial search times for the two approaches are almost similar—of the range
of 0.30 seconds. The traditional approach takes 0.33 seconds as given in Figure 5-9(b),
and the constructivist’s approach takes 0.37 seconds, as given in Figure 5-9 (a).

It can be seen that the constructivist keywords are more exact compared to the
traditional approach. As air pollution is a part of environmental pollution, it rules out
redundancy in data by specifying only those websites that are needed for the particular
search. It may seem that the traditional approach is more extensive as environmental
pollution includes air pollution, but this is not exactly the situation. A lot of redundant
data forms a part of the search and this may lead to repetition in websites as well. The
constructivist approach has a more focused way of retrieval.
Figure 5-8 Traditional approach from http://www.esf.edu/

Figure 5-9 (a) Constructivist’s search, time duration measurement, step 1.
Figure 5-9 (b) Traditional search, time duration measurement, step 1.

Once the website page is given, Figure 5-9 (a), the time for selecting the most appropriate website is considered as to how easily it can be found on the first page. Accurate results for the constructivist’s approach are present in the second website, in Figure 5-10 (a) and Figure 5-10 (b) where as for the traditional approach, somewhat close results are obtained in the ninth website listed. This screening process takes time and determines which approach is faster.

Though retrieval times are not a direct measure of how good an approach is, when compared they do give a certain amount of time wastage involved. When an approach is found to be saving time over another, it gives more time for subsequent searches and searching for a topic more deeply. The traditional approach takes more time overall and so leads to a lot of time wastage. The large numbers of websites retrieved do not give time to the retriever to focus on the keyword. Even though there is much more information, weeding out information which is not relevant takes up a lot of time and diverts the retriever from the main topic. Data is obtained much more easily in the constructivist’s approach and there is more time to look into the contents of websites.
Figure 5-10 (a) Constructivist search results on second website listed.

In the traditional search, Figure 5.10 (c) the first few websites are from Wikipedia, handbooks, www.amazon.com books, and the projects which are not direct sources of research. The ninth website is somewhat close to the search criterion.

Thus, it can be seen that the constructivist’s approach leads to quicker and exacting results. More time is saved compared to the traditional approach where the websites are not apt and not listed in order of priority to the required search. So the 0.30 seconds saved initially in the traditional search for this example are not that critical in deciding which approach is faster. Since more common words are put into the traditional search, the results are obtained faster initially for the traditional approach. The constructivist's approach, however, gets the advantage of making the overall search process fast.
Figure 5-10 (b) Constructivist’s website results from http://www.epa.gov/apccdwww/

Figure 5-10 (c) Traditional search results from http://www.pca.state.mn.us/oea/index.html
CHAPTER 6

CONSTRUCTIVISM DURING DYNAMIC TESTING OF INFORMATION RETRIEVAL

6.1 Introduction

As mentioned in section 2.1.4, dynamic testing is similar to conducting real life experiments with testing parameters. The real life testing part has been amply demonstrated in the previous sections. In this section the focus will be on experience and flexibility of application, practicality and goal directed searches.

6.2 Experience and flexibility of application

The importance of previous experience in selecting the keywords in the first search has already been demonstrated in Chapter 3. The constructivist’s theory keeps experience in mind so the search is deeper than a simple word search. It may be noted that even after the simple word search, constructivist’s principles can be applied, and it is flexible in applicability. Experience with a particular area greatly helps the constructivist’s retriever in building up on information. The traditional search may also seem to benefit the more experienced learners, but in the constructivist’s approach, experience comes in handy while searching and hence makes it more flexible. Suppose a learner knows more about a topic which he wants to study further. Keeping his own experiences in mind, he can select those pieces of information in websites that he considers will further his research. It is the experience of the learner on a particular topic that is being counted here and not the overall experience of a traditional learner in years.
This aspect of search is different from that of a simple word search; the study is deeper. It allows research in the direction in which the retriever wishes to pursue his interests. The constructivist’s approach is flexible enough to include the word search at any point of time. Thus, there is an added advantage to the constructivist’s search. To illustrate this with an example, consider the two kinds of searches again with the following keywords:

Constructivist’s search: air pollution control + university

Traditional search: environmental control + university

The constructivist’s keywords would give an air pollution control specific list of websites as given in the Figure 6-1. The retriever knows which area is in focus so finding data is not all that difficult anymore. This search is more exacting and more deeply focused on the subject.

Experience of the retriever helps him to reflect back at all the knowledge he already has on the search criteria. This enables him to weed out information that is not relevant and thus successfully apply it to the search process. New ideas are cultivated in this process and the retriever gets a background of the subject by revisiting what is in his mind already on the search criterion. The example shown helps the retriever to focus on exactly what information he needs out of the search process. In this way a lot of redundancy in the system is reduced. It gives a chance to the retriever to make his own decisions which are a result of his prior experience on a topic. This interactive process helps in finding the right kind of information.
The experience of the learner is highly interactive in the constructivist’s search. It is interactive in nature. The whole search process is simplified when the retriever’s experience is combined with the keyword search. This process takes place in the traditional search as well but to a very little extent. The constructivist retriever has the chance of reducing search time and making the search process more focused by looking for information that he needs to find. The traditional retriever, on the other hand, has fewer options when he does not combine his experience and searches with a few keywords in mind.
Let us explore one website and see how the retrieved information is deeper into the subject.

![Image of a website](http://watcar.uwaterloo.ca/env/pollution.html)

**Figure 6-2** Research specific websites on air pollution control from http://watcar.uwaterloo.ca/env/pollution.html

From Figure 6-2, it can be seen that the different areas of research within air pollution control are listed. The retriever’s experience would help in deciding which field he would like to pursue further and find links or type keywords related to his intended...
refined search. If the ‘urban dispersion modeling’ option is chosen, then it further gives the required information on that topic. Getting to the topic no longer becomes a difficulty. For further search, keywords used within the websites for different fields can be used again. So there is a flow of information soon after using one’s experience and intentions in search are redirected to a particular topic. Chances of redundancy are minimized and there is more probability of getting the required data in the first attempt. Figure 6-3 gives a clear idea of the subject in search.

![Laboratory Home Page](http://www.mme.uwaterloo.ca/research/fluids/envirofluids.html)

**Figure 6-3** Details for research presented using the constructivist’s search from http://www.mme.uwaterloo.ca/research/fluids/envirofluids.html
The keywords in the two approaches have been kept close enough in order to distinguish their features carefully. The website selected from the traditional approach keyword gives a long list of colleges according to states as given in Figure 6-2. It is very lengthy and is not area specific. Here the experience of the retriever is not coming in to play as general keywords have been used. Focus of the search is not directed in this word search as the intentions of the user are not included. There is a wide range of colleges listed, but none according to their area of research based on the retriever’s interests.

*Figure 6-4 Traditional approach results from the website http://www.ed-reference.us/00110/environmental/environmental-control-technologies,-technicians/colleges#*
6.3 Practicality

The constructivist’s approach turns out to be more practical in retrieving information. It has been listed above how the constructivist’s approach includes the experiences of the retriever while doing the search. This makes it more practical as lists of websites may seem useful but are not required when there is a search for a particular field.

In the example given in section 6.2, to be able to reach a required website quickly is more important than scanning through various sites and still not being able to get the required information. Search criteria in the constructivist’s approach may not be all that complete but leads to the right websites. The traditional approach is more like studying a book from the beginning to the end when only a couple of pages in one chapter need to be referenced. Solutions in the constructivist’s approach are faster to reach and more exact. When there are choices available to retrieve information in the faster way, the traditional approach lags behind due to its slow approach. Keywords put in the search criteria do not make a difference when it comes to comparing the ultimate information available in websites. So the constructivist’s approach is more flexible and practical in its applicability.

6.4 Goal-directed searches

Usually, in the traditional search approach, the focus is more on finding similar words that match the keywords. Keywords play a decisive role in the information retrieval process as the related search is fully based on them. The better the keywords, the
more specific the search in the case of the traditional word search. Keyword selection is important in the constructivist’s case as well but the search following it does not blindly rely on their selection. Here the keywords are representatives of information contained in them. It is the knowledge inside the websites that is the determining criteria of information quality and not simply the number of websites that have more words. Both the number of matching words and information value will be put side-by-side in the following example. Let us take again the keywords for both the traditional as well as constructivist cases which are similar but do not have the same words.

- Constructivist’s keywords: excelling environmental colleges
- Traditional keywords: top 50 environmental colleges

Although the searches may look similar as they are asking for a list of colleges which do extremely well, the constructivist’s approach leaves scope for the cream of colleges with awarded research work. The traditional approach demands a list of colleges but their ranking has no defined basis. The keyword ‘excelling’ puts colleges that are above the rest with some kind of specialty in them. The keywords ‘top 10’ merely lists colleges with rankings that could be based on any criteria like low tuition college, ranking in state colleges, or other mixed criteria that might affect the academic or research ranking.

The results for the constructivist’s search, Figure 6-5, give four relevant sites as compared to three for the traditional search. These websites were taken out of the first page of the website. As pages proceed in a search, the level of importance of documents retrieved decreases as the most important documents have a higher priority. That is why
only the very first page of website search has been referenced. The number of useful websites is very close between the two cases but still the websites in the constructivist’s approach are more meaningful and related to the topic.

Figure 6-5 Goal directed constructivist search options.

It is interesting to note in Figure 6-5 that even though some of the website descriptions do not even have all the search keywords in them, that is, the websites are not purely based on matching words, but the information in the websites is clearer and directed towards the goal. Four websites are found to be relevant to the topic with a clear description of the kind of research that is making their college excel in some way. Here
the goal is not of finding a list of all environmental colleges throughout the country but of finding data on ongoing excelling research to gain knowledge. The approach of finding colleges which suit a particular criterion is more goal-oriented than that of finding a list of colleges which are remotely connected to the search criteria with information overloads. Let us see the results of the traditional keyword search.

In Figure 6-6, only three websites are related to the search. Also, the information content is not that relevant as mainly lists are being searched out. Even the keywords “top 50” did not lead to an accurate number of websites. Two of them were top 10 colleges and the third had a list of top 15 colleges. So the search criteria were not complete in most of the cases. As the website pages proceed, the relative importance of websites decreases.

Both these searches were intended to find a similar goal using the two different approaches of the constructivist and the traditional search. The constructivist’s search procedure lead to an increased number of relevant websites related to the goal. As the keyword “excelling” was an applied one and not a direct one like “top 50” as in the case of the traditional search, the “meaning-making” aspect of constructivism came to play a decisive role. The meaning behind an idea is more important than the few keywords chosen to describe it. The keywords have a role once the idea to be conveyed has been totally absorbed by the keywords. The traditional approach on the other hand had a definite list (top 50) of keywords but this actually was a constraint on the number of colleges rather than a specific advantage. These keywords excluded other options for websites like top 100 or top 500 colleges.
Thus the constructivist’s websites retrieved are more goal-oriented. Further advanced search on the topic also yields similar results. Then, the experience of the retriever on the topic can direct him to choose keywords accordingly. For the traditional
retriever, there are fewer options if experience is not made handy and only words are considered the ultimate tool to retrieve information. It is also possible that a document may have lots of partial keywords but may lead to lots of redundancy being introduced into the system. For example “environmental colleges” is different from “engineering colleges” though they may seem to be interrelated and also have the same keyword “colleges” in them. From the websites retrieved, there would be a huge list of colleges but very few would have the “environmental engineering” option in them. So, simple word searches may often be time consuming and not lead to the desired websites. Connecting ideas behind the search is more useful specially if it is a first time search or else the user’s experiences should be allowed to come into play. There is a general tendency to look into the first five-to-ten websites and consider them carefully in the traditional approach. Constructivism is an approach which provides a much clearer and less confusing way to retrieve information. Individual choices are driven by the experience of the retriever on the subject and help in providing a guideline to the search. Interacting with the knowledge given in websites, to determine whether it suits one’s requirements or not, leads to a better understanding of the subject and this, in turn, makes further searches on the topic even more efficient. The constructivist’s approach also follows this scheme to some extent as the topmost websites have higher relevancy to the topic at hand, but being able to pick and choose websites according to one’s experience gives more scope to a meaningful search.

This theory helps in keeping the attention of the retriever on the main topic to get most out of the website which is what information retrieval is about. The constructivist’s
approach proves to be more focused. Attention is not side-tracked by lists of information present in other websites. The traditional approach has many reasons to deviate from the topic as a number of websites with a broad range of colleges are listed. Further searches on the same topic and advanced searches give information which is more difficult to sort out in the traditional search. As the constructivist’s search is driven by better keywords and choices of the retriever, lots or irrelevant material is removed in the search.
CHAPTER 7

SUMMARY OF RESULTS OF EXPERIMENTS AND DISCUSSION

Exhaustive experiments have been carried out in chapters 3-6 to analyze the contribution of constructivism in information retrieval through selecting and recomposing keywords by relying on conceptual perception, insightful examination, analysis of actual occurrence and response to dynamic phenomenon during testing. These results are then compared with the traditional approach of complete reliance on non-intuitive keyword selection (not utilizing the previous precious experience of subject knowledge) by using mechanical (no thought process involved in selecting the websites) and arbitrary responses (not carrying out the insightful examination of the information received) during the information retrieval process. As already discussed in detail in chapters 3-6, the results of all experiments, summarized again in Table 7-1, show that the constructivist based approach, on overall assessment, fares better than the traditional approach. In some cases, the initial response is slow (taking more time for the web sites to come up) and less in quantity (number of websites displayed is less), but the approach on constructivism ultimately wins and brings out more relevant and useful information to the retriever.

An important finding of this work, evident from the results of the experiments conducted, is that the website knowledge providers can themselves save time (contact time of the retriever on the website) by approaching and guiding the user in a constructivist’s way. The tables give a summary of the results of on-line experiments carried out for both the approaches.
Table 7-1

Constructivism in Conceptual Perception and Its Effect on Information Retrieval

<table>
<thead>
<tr>
<th>S.no</th>
<th>Description of parameter</th>
<th>Relative performance of the constructivist’s approach</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.1</td>
<td>Keyword selection: Traditional versus constructivist search test on <a href="http://www.google.com">www.google.com</a></td>
<td>Keywords are fewer in number and yet more precise in retrieving information</td>
</tr>
<tr>
<td>1.2</td>
<td>Cultivation of new ideas</td>
<td>Improved performance and faster search with newer ideas generated during the search</td>
</tr>
<tr>
<td>1.3</td>
<td>Reduced idle time</td>
<td>Ultimately, the idle time in search process gets reduced</td>
</tr>
<tr>
<td>1.4</td>
<td>Learner-friendly and fun method: experiment 1</td>
<td>The user is actively engaged in the search process and the search is faster</td>
</tr>
<tr>
<td>1.5</td>
<td>Learner-friendly and fun method: experiment 2</td>
<td>The result is same as in experiment 1; the user is actively engaged in the search process and the search is faster</td>
</tr>
</tbody>
</table>
Table 7-2

_Constructivism in Insightful Examination and Its Effect on Information Retrieval_

<table>
<thead>
<tr>
<th>S.No.</th>
<th>Description of parameters</th>
<th>Advantage of the constructivist’s approach</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Comprehensiveness of data received</td>
<td>The search results are finally more complete, even though initially the number of sites retrieved are less</td>
</tr>
<tr>
<td>2.</td>
<td>Integrity of data</td>
<td>Data is better organized and well linked</td>
</tr>
<tr>
<td>1.</td>
<td>Reliability of data</td>
<td>Data presented is interreliant and consistent from one search to another.</td>
</tr>
<tr>
<td>2.</td>
<td>Compliance to data formats</td>
<td>Formats from one website to another are similar and hence less confusion</td>
</tr>
<tr>
<td>3.</td>
<td>Precision and accuracy of data</td>
<td>The basis on which data accuracy can be judged is well defined and precise</td>
</tr>
</tbody>
</table>
It is suggested that during the retrieval process some questions can be posed to the retriever (person engaged in the search process) so that he is forced to think before selecting an option and proceeding to the next step. The pictures and video contents can be aptly filled into the website to make the selection process easier in the constructivist way, because they will ultimately reduce the total retrieval time and also provide more success and satisfaction to the retriever.

The results of this study show that a lot of developmental effort will be needed in converting the knowledge base in the websites to fully suit the requirements of the constructivist’s approach but once that is done the websites would be treated more intelligently and utilized more efficiently too. On the other hand the user also will need to change his thinking and orientation in the more intelligent constructivist way.

Subjectivity in decision making was taken into account. Peoples views could differ on the choice of keywords, choosing websites and narrowing down to the final websites. However, keeping all these in mind, the differences between the two approaches is obvious. The constructivist’s approach was found to be a definite improvement over the traditional approach. The ideas put into keywords in the constructivist approach rise from a combination of experience and interaction with the topic. The traditional search, however, is driven by words in the word search. This obviously puts a limit to the search process as words cannot convey an idea as well as proper keywords chosen by the traditional approach. The traditional approach proves to be more extensive but the more focused approached of the constructivist’s approach leads in information retrieval.
Table 7-3

*Constructivism in the Analysis of Actual Occurrence and Its Effect on Information Retrieval*

<table>
<thead>
<tr>
<th>S.No.</th>
<th>Description of parameters</th>
<th>Advantage of the constructivist’s approach</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Repetition of data</td>
<td>Due to a focused search, repetition of data is far less and hence the selection process is faster from one step to another</td>
</tr>
<tr>
<td>2.</td>
<td>More reliance on real life examples and less reliance on theory</td>
<td>Inherent experience of the user plays a major role; this also becomes a disadvantage if the user has no prior experience or little knowledge of the field</td>
</tr>
<tr>
<td>1.</td>
<td>Faster processing time for retrieval</td>
<td>Processing time is definitely faster</td>
</tr>
</tbody>
</table>
Table 7-4

*Constructivism during Dynamic Testing*

<table>
<thead>
<tr>
<th>S.No.</th>
<th>Description of parameters</th>
<th>Advantage of the constructivist’s approach</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Experience and flexibility of application</td>
<td>Maximum scope for applying experience; more flexible and practical as the search converges and proceeds deeper into the topic</td>
</tr>
<tr>
<td>2.</td>
<td>Practicality</td>
<td>Able to obtain the required information faster</td>
</tr>
<tr>
<td>1.</td>
<td>Goal-directed searches</td>
<td>Able to land at the required website faster</td>
</tr>
</tbody>
</table>
Surprisingly, a recent report in the Times of India, Nov. 16, 2009, “Seeking, intelligent search helpers.” by Kavita Kukday-Deb, focuses on tapping services which promise to read the individual’s mind and accordingly customize information that reaches him during the retrieval process. This is somewhat similar to customizing to the taste of an individual by analyzing the queries or keywords that he feeds during the search. For example, www.ensembli.com asks the searcher first a few topics in an area and then the service refines the selection at each step, based on the search words entered and the sites selected for viewing. The initial contents are largely what the other users in
that area had clicked on, but gradually the search results become more and more refined by pattern matching. Eventually, when the application has gathered enough data, it remembers the type of selections or queries posed by the viewer. It then categorizes and retains, through a routine called Sobees, the information seen by the viewer for future use. There is thus a small input of constructivism in this effort to streamline the search from the service provider or the web designer’s end. It can be said that constructivism has just begun to make inroads into the world of information retrieval.
CHAPTER 8

CONCLUSION

Internet has become a good storehouse of knowledge and almost a first step in the research process but the retrieval of information from the Internet in an efficient manner is not an easy process. Present work shows that the use of constructivism in information retrieval may help to make the retrieval efficient, faster, more organized and enjoyable in many ways.

The philosophical aspects of constructivism are reviewed. The concept of constructivism in the learning process is deeply rooted in ontology and epistemology. Knowing how to approach to learn and gather information is important. A person understands first by reconstructing and then rediscovering it himself from the knowledge being conveyed or presented. It encourages ‘meaning making’ and helps to provide a new base for the ideas to develop. Since learning is individual, the psychology of the individual plays a decisive role.

The role of constructivism in the process of learning in information retrieval is critically evaluated by carrying out on-line experiments on the Internet. In the experiments conducted, a comparison is made between the constructivist’s approach, in which the background knowledge and intellect of the person himself plays an important role in the selection of the combination of keywords, and the traditional approach in which the search process is more mechanical and guided by what the websites presents to him on the screen at a particular moment.
In this work, first a conceptual model or a framework of the learning process is created in which the four main pillars, in sequence, are taken as (a) conceptual perception, (b) insightful examination, (c) actual occurrence, and (d) dynamic testing. The significance of these pillars is explained and the parameters which can be used for evaluation of information retrieval for each of the cases (a)-(d) are identified.

In the case of the conceptual perception criterion, keyword selection and framing the combination of keywords is the first and most important step in the quest of knowledge and also for the success of the search and retrieval process. Results of on-line experiments show that good keywords chosen on the lines of the constructivist’s approach lead to cultivation of new ideas with a reduction in idle time and a learner-friendly and fun filled approach. Reduced idle times help to maintain the concentration of thoughts. Since the approach is learner friendly in the intellectual sense, it can be said to be more enjoyable and helpful as evidenced.

The insightful examination criterion was tested on several grounds, including information reliability, integrity, and comprehensiveness, compliance to data formats, precision and accuracy of data. The result of the experiments show evidence that they are more successful and rewarding because, while analyzing data, the constructivist retriever keeps a better track of the subject in mind, thereby letting his interaction and experience with the research topic drive the search.

The third parameter, actual occurrence, was measured against standards such as reliance on real life examples versus reliance on theory, repetition of data, and faster processing times for retrieval. The results of experiments show evidence of the
superiority of the constructivist approach over the traditional approach. In the constructivist’s approach, repetition is reduced and the retriever is more reliant on experience, yielding, on the whole, to a faster processing time. Redundancy is significantly reduced and it does not compel the reader to read loads of un-related information. In the traditional approach, not much thought goes in, at least in the initial stages, and it leads to a number of repetitions before the desired website is approached.

The final criterion of dynamic testing involves the assessments on one’s own experience as the search process proceeds. Experiments are done to evaluate the flexibility of application, practicality, and ability to reach the goal in a short time (or the goal directed search is evaluated). In this case as well, the constructivist’s approach could be a possible improvement over the traditional approach as evidenced.

The phenomenon of information overlap, role of subjectivity and the contribution of speed reading are also studied as they affect the efficiency of the retrieval process. The relative advantages of the constructivist’s approach on information retrieval are described. While looking for information, speed reading and constructivist thinking, together, encourage the most advantageous use of brain power. A focused and fast reading style weeds out the information which is not relevant and thereby saves a lot of time spent in the subsequent search steps. Constructivism adds ingenious selectivity to the speed reading exercise itself as evidenced.

The results, on the whole, are very strongly in favor of using the constructivist’s approach as an improvement over the traditional approach. It is observed that websites
such as www.ensembl.com could help formulate keyword selection criteria and also give choices of websites before conducting the whole search.

The constructivist’s approach offers a definite advantage in acquiring the right information. In relation to the individual, it is found that the basic advantage of constructivism in the learning process is that it helps in creating a flexible mind to seek information with greater correspondence to the perception and the specific needs of the person concerned. It helps to generate more ideas to search intelligently. The user’s memory power increases. Since there is a greater participation of the learner, the data selected gives rise to newer thoughts on the topic as the search proceeds. The mental model thus created favors a superb crossover point giving fillip to the most recent thought processes in the mind of the individual. As a result, the research itself is on the cutting edge, rather than simply improving on facts and previous results available on the Internet. Thus the favored appropriate approach should be the constructivist’s approach as it leads to an exciting and efficient information retrieval process.
CHAPTER 9

RECOMMENDATIONS FOR FURTHER WORK

The traditional approach, though popular and apparently user friendly to yield a large volume of data retrieved, has severe limitations in both the quality and relevance of the material retrieved. The constructivist’s approach offers many advantages in information retrieval over the traditional approach. It is recommended that if the experiments with measured and varied combinations of the constructivist’s and traditional approach are conducted, the results would be highly beneficial for setting a new base of learning and information retrieval. These experiments can be area specific such that the user is posed or suggested some options to select from while the search is in progress so that it aids and refines his thought process to make the right choices. The interaction with the website will then become more intelligent and hence more productive and fast too, simply because the number of sites and pages to read will be substantially reduced. This will help the site providers too because the time for which the user will be logged-on to the website will be less and hence the same website can be used by more number of persons at the same time.
REFERENCES


