Creative information seeking Part I : a conceptual framework

Theng, Yin-Leng; Lee, Shu Shing; Goh, Dion Hoe-Lian

2005

Creative Information Seeking Part I: A Conceptual Framework

Shu-Shing Lee, Yin-Leng Theng and Dion Hoe-Lian Goh

Authors' Autobiographical Note

Shu-Shing Lee
School of Communication and Information
Nanyang Technological University
31 Nanyang Link
Singapore 637718

Email address: ps7918592b@ntu.edu.sg
Telephone: (65) 6790-6565
Fax: (65) 6791-5214

Shu-Shing completed her MSc (Information Studies) in 2002 at Nanyang
Technological University (Singapore). Currently, she is a PhD student at
the Division of Information Studies, School of Communication and
Information, Nanyang Technological University (Singapore). Her research
interests include creativity, digital libraries and information seeking.

Yin-Leng Theng
School of Communication and Information
Nanyang Technological University
31 Nanyang Link
Singapore 637718

Email address: tyltheng@ntu.edu.sg
Telephone: (65) 6790-5834
Fax: (65) 6791-5214

Dr. Theng completed her PhD in 1997 on addressing the "lost in
hyperspace" problem in hypertext, and proposed a framework to
understand design and usability issues. She then joined Middlesex
University (London) as a Lecturer from 1998 to 2001. Currently, she is an
Assistant Professor at the Division of Information Studies, School of
Communication and Information, Nanyang Technological University
(Singapore). She teaches on the Information Studies Master Programme:
Digital Libraries and Human-Computer Interaction. Her research interests
in Human-Computer Interaction and Digital Libraries had led to the award
of two research grants from the Engineering and Physical Science Research

1

Council in the United Kingdom during her four years of teaching at Middlesex University. She has just received a research grant to work on improving usability evaluation techniques for the mobile and Web environment.

Dion Hoe-Lian Goh
School of Communication and Information
Nanyang Technological University
31 Nanyang Link
Singapore 637718

Email address: ashlgoh@ntu.edu.sg
Telephone: (65) 6790-6290
Fax: (65) 6791-5214

Dr. Goh has a PhD in Computer Science from Texas A&M University. He is an Assistant Professor at the Division of Information Studies, School of Communication and Information, Nanyang Technological University (Singapore) where he teaches IT-related courses for the Master's programme in Information Studies. His research interests are in digital library applications, the use of information technology in education, and the application of Internet technologies to support these fields. His other interest areas include hypermedia and multimedia systems as well as user interfaces.

Creative Information Seeking Part I: A Conceptual Framework

Abstract

This paper proposes a conceptual framework for creative information seeking drawing upon Weisberg's argument that creativity exists in everyone, and mapping the creative process described in the holistic model of creativity to the information seeking activities identified in the behavioural model of information seeking. Using scenarios of information seeking behaviour, mappings between the creative process and the information seeking activities were refined and six stages for creative information seeking were proposed. These scenarios were also used to provide theoretical justifications for each stage in creative information seeking.

Evidence gathered from the scenarios seemed to indicate that the type of information seeking task may have an impact on the extent to which the information seeker exhibits all stages in the framework. This is on-going research. Part II of this paper aims to conduct empirical studies and gather evidence to verify the framework and examine this observation in more detail.

Introduction

Current information retrieval (IR) systems are designed to judge precision and recall based on a match between index and query terms. This mode of operation is the 'best-match' principle (Belkin, 1982). Precision and recall measures using this principle are limited due to its assumptions.

The 'best-match' principle assumes that users can specify their information needs in a query. Unfortunately, this is difficult as users are unfamiliar with the system's operations, vocabularies used to describe its documents, and characteristics of information in the system (Belkin, 2000). Hence, documents retrieved may be irrelevant to users.

IR systems built using the 'best-match' principle also assume that the perspectives and words used to describe documents are similar between indexers and users. This assumption limits precision and recall measures, as indexers are experts in their subject areas and describe documents based on their properties (Henninger, 1996). Users, on the other hand, are less knowledgeable and hence use terminologies that differ from experts.

The third limitation of the 'best-match' principle is the assumption that documents retrieved are relevant to the user. Such a measure of relevance is limited, as it does not consider the contextual nature of human judgement. Measures of precision and recall should take into account that relevance is subjective (Kuhlthau, 1993) and is influenced by the knowledge states and intentions of users (Case, 2002).

Weisberg argues that everyone has creative traits and creativity is a result of ordinary thinking, which is a continuity of the past (Weisberg, 1993). Individuals deal with new situations based on prior experiences in similar situations. Likewise, Amabile argues that the creative process used by individuals is similar regardless of the domains they come from (Amabile, 1990). Using Weisberg's (1993) argument, an assumption can be made that every information seeker is creative and hence engages in creative information seeking.

Establishing a relationship between 'creativity' and 'information seeking' is important as it provides a different perspective of information seeking leading to new and perhaps improved ways of developing systems and interfaces for supporting information seeking. Such a perspective sees a creative process as inherent in information seeking and may, therefore, improve query formulation and refinement, searching, browsing, and filtering, thereby, providing better system support to help users better understand their information needs. Using the assumption made earlier, this paper proposes that looking at information seeking from a creative perspective may possibly help address some of the limitations of current IR systems.

In order to establish a relationship between 'creativity' and 'information seeking', this paper begins with a survey of creativity and information seeking models. Based on the survey, stages to creative information seeking are formulated. These stages are established through a mapping of

a creativity model and an information seeking model. Scenarios of information seeking were then used to clarify these mappings so that the model for creative information seeking could be conceptualised.

Survey of Creativity Models

Creativity means different things to different people. One definition associates it with the genius. Weisberg highlights that attempts to understand creativity is largely dominated by the 'genius' view, which associates creative achievements as results of great individuals using extraordinary processes(Weisberg, 1993). However, he argues that creativity is a trait everyone has and that novelty results from the use of similar thinking processes when a particular person is put in a particular environment. He emphasizes that his argument is not trying to claim that great individuals who produce original works are the same as ordinary individuals but that the thinking processes used are similar.

Other definitions of creativity associate it with process-oriented or product-oriented views. The process-oriented definition highlights creativity as a process that results in innovative products (Edmonds, 2002; Kazanjian, 2000). Product-oriented views associate creativity to attributes of the outcome. Only when an outcome is both novel and valuable can creativity be said to have happened (Akin, 1998).

Creativity can also be defined using a number of models. Models described briefly in this paper include the systems' view of creativity, the

7

componential model of a creative process, and the holistic model of creativity.

Systems' View of Creativity

The systems' view of creativity argues that creativity is a result of social systems making judgements of the individual (Csikszentmihalyi, 1990). Here, creativity is a result of an interaction between three subsystems: (1) a domain; (2) a field; and (3) a person. The roles and relationships of each subsystem are illustrated in Figure 1. In this model, no creative product exists without an input from each of the subsystems.

"Take in Figure 1."

Figure 1 also illustrates that a typical cycle of the model starts with the domain, which transmits information to the individual. The individual receives the information and transforms it. The field then makes a judgement of whether the transformation is valuable to society. If it is valuable, it would be included in the domain of knowledge, hence providing a new starting point for another cycle of transformation and evaluation (Csikszentmihalyi, 1990; Saunders, 2002).

Componential Model of a Creative Process

Amabile's componential model of a creative process focuses on stages a creative person undergoes to produce a creative product and elements in the environment that influence each stage (Amabile, 1990). Stages of the

creative process in this model are task representation, preparation, response generation, response validation, and outcome evaluation. Elements in the environment that influence these stages include, task motivation, domain-relevant skills, and creativity-relevant skills. Figure 2 shows the flow of these stages and how elements in the environment influence the creative process.

"Take in Figure 2."

Amabile reveals that the outcome of one cycle of the creative process has a direct influence on all three environmental elements in future engagements of similar tasks (Amabile, 1990). Hence, a feedback loop is established. Moreover, the application of this model is dependent on the complexity of the task. This means that for a complex task, several long loops through the stages may be necessary before a successful product is achieved.

Holistic Model of Creativity

Rhodes attempted to find one unifying definition of creativity but discovered that creativity is subjective and difficult to define (Rhodes, 1961). When analysed, the content of definitions form four fundamental areas of inquiry: (1) a creative person; (2) process; (3) product; and (4) environment. Similarly, Mooney (1963) and Weisberg (1993) highlighted that a description of creativity should encompass these elements. Such a description is termed here as the holistic model of creativity. This model will be used to establish a relationship between 'creativity' and

'information seeking' as it recognises creativity from all aspects encompassing the person, process, product, and environment.

Synthesizing the different views for creativity (Mooney, 1963; Rhodes, 1961; Weisberg, 1993), this paper identifies attributes of a holistic model of creativity focusing on four fundamental aspects of a creative person, process, product, and environment.

The Creative Person

The creative person in this model should have imagination, independence, and divergent thinking (Diakidoy, 1999). The ability to see interrelationships is a key feature and helps a person break away from conventional ideas when one faces a dead end. King and Pope (1999) also associate the creative person with psychological richness, complexity, and openness to experience.

The Creative Process

In order to produce a creative product, the creative individual goes through four stages: preparation; incubation; illumination; and verification (Gabora, 2002). The flow and description of these stages are illustrated in Figure 3.

"Take in Figure 3."

The Creative Product

The creative product should satisfy two properties, novelty and value (Weisberg, 1993; Akin, 1998; Fischer, 1997). Novelty is determined by comparing the new product with existing ones (Akin, 1998; Fischer, 1997). In other words, a novel product is one that is different from all previously created products for similar purposes. Value is concerned with the relevance of the product to human purposes (Akin, 1998). Amabile also explains that judgement of a creative product depends on a group of appropriate observers (Amabile, 1993).

The Creative Environment

Attributes of a creative environment include boldness, courage, freedom, spontaneity, clarity, and self-acceptance (Maslow, 1959). The environment should also support collaboration since idea generation does not occur in isolation but rather grows out of relationships between individuals (Drazin, 1999; MacCrimmon, 1994).

Survey of Information Seeking Models

In the previous section, different definitions and models of creativity are surveyed. In this section, three established information seeking models are discussed to provide rationale to underpin possible mappings between 'creativity' and 'information seeking'. These information seeking models are Wilson's model of information seeking behaviour (Wilson, 1981),

Kuhlthau's model of the information search process (Kuhlthau, 1993), and the behavioural model of information seeking (Ellis, 1989; Ellis, 1993).

Model of Information Seeking Behaviour

Wilson's model is a macro-model of information seeking (Wilson, 1981). It focuses specifically on motivation factors that trigger information seeking behaviour, elements in the environment that affect these motivation factors, and barriers to information seeking behaviour.

In this model, information seeking behaviour / activity is triggered by three motivation factors: (1) physiological needs (that is, survival needs for food, water, and shelter); (2) affective / psychological / emotional needs such as the need for attainment and domination; and (3) cognitive needs such as the need to learn a new skill. These motivation factors are also influenced by the social role of an individual. This social role refers to the role an individual performs in life or work. The model also goes on to highlight that the three motivation factors do not necessarily trigger information seeking behaviour, as other 'external' factors may hinder it. The model does not explicitly highlight what these 'external' factors are but broadly mention them as personal, interpersonal, and environment barriers to information seeking.

Essentially, this model shows that information needs and information seeking behaviour is a function of needs, social role, and the environment.

Thus, information needs and information seeking behaviour is subjective as everybody's role and environment is influenced by different factors.

Model of the Information Search Process

In contrast to Wilson's model (1981), Kuhlthau's (1993) model focuses on the feelings, thoughts, and actions associated with different stages in the "information search process". These stages are initiation, selection, exploration, formulation, collection, and presentation.

The model highlights that at the start (*initiation)* thoughts are vague and confused. As the information seeker goes through the stages from initiation to presentation, thoughts become clearer as he / she gains a personal understanding of the problem. At the same time, his / her feelings begin to evolve from anxiety and confusion to increased confidence and interest as he / she progresses through stages of the information search process. A detailed description of the feelings, thoughts, and actions associated with each stage in this model's information search process is provided in Table I.

"Take in Table I."

Behavioural Model of Information Seeking

The third information seeking model that is examined to help identify possible mappings between 'creativity' models and 'information seeking'

models is the behavioural model of information seeking (Ellis, 1989; Ellis, 1993).

The behavioural model of information seeking focuses specifically on the generic categories of activities in information seeking. It takes into account the subjective sequence of such activities, which varies according to the context and circumstances of the seeker at that point of time. This model is used to establish a relationship between 'creativity' and 'information seeking'.

In this model, the information seeker undergoes eight generic activities. The first activity is *starting*. This refers to activities characteristic of the initial search for information on a new topic / area. The seeker may have some or no familiarity with the topic / area. Examples of these activities include asking colleagues, consulting literature reviews, referring to starter reference catalogues, abstracts, and indexes.

The second activity is *chaining*. This refers to following chains of citation connections between materials, which can be forward chaining and backward chaining. Forward chaining involves the use of citation indexes or bibliographic tools to identify citations to relevant materials. Backward chaining refers to following up references cited in materials consulted.

The third activity, *browsing*, involves conducting semi-structured or semi-directed searching in an area of potential interest. Activities in this stage

include browsing table of contents in journals, checking sources available in the library, and browsing along shelves.

The fourth activity is *differentiating*. This activity is concerned with using characteristics / differences in information sources to filter the amount of information obtained. Some characteristics for filtering include topic of study, creditability, author, type of source, and language.

Monitoring, the fifth activity, is about continuously maintaining awareness of developments in a field through regular monitoring of particular sources. Methods that information seekers use include the use of informal contacts, monitoring services, research directories, and journals and publishers' catalogues.

The sixth activity, *extracting*, is concerned with systemically working through a particular source to selectively locate materials of interest. This activity requires the seeker to set aside substantial amount of time to go through sources, like journals, books, computer databases, and indexes to locate information of interest. This activity is the most directed among all information seeking activities.

The seventh and eighth activities are *verifying* and *ending* respectively. Verifying involves checking the accuracy of information. Ending includes activities characteristic of information seeking found at the end of a topic / project, for example, returning to the literature during preparation of papers so that the accomplished work can be discussed in light of related works.

Table II summarises activities in this model.

"Take in Table II."

Stages for Creative Information Seeking

In this section, mappings between the holistic model of creativity and the behavioural model of information seeking (Ellis, 1989; Ellis, 1993) are proposed. The holistic model of creativity and the behavioural model of information seeking (Ellis, 1989; Ellis, 1993) were selected to establish mappings as they were surveyed in more detail than the other creativity and information seeking models.

Establishing Mappings between 'Creativity' and 'Information Seeking'

The survey of creativity and information seeking models highlighted several similarities between the 'creative process' in the holistic model and the behavioural model of information seeking. Hence, a detailed walkthrough was conducted. The walkthrough involved systematically analysing and comparing each stage in a 'creative process' with 'activities' in the behavioural model of information seeking for similarities. When similarities between stages and activities were found, a link was established. The four common links established and rationale behind each link is described below.

- *Link #1* – Preparation in the 'creative process' (see Figure 3) is concerned with collecting all necessary information to facilitate

creativity. Thus, this stage is linked to starting, chaining, and browsing in 'information seeking' (see Table II, rows 2-4) as these behaviours are also concerned with collecting information. The rationale behind this link is based on the fact that objectives of preparation, starting, chaining, and browsing are concerned with gathering information. The only difference is their contexts. For example, preparation is concerned with gathering information to facilitate creation while starting, chaining and browsing are concerned with gathering information through means of searching, following chains of references and browsing respectively to address an information need.

- *Link #2* - Incubation in the 'creative process' (see Figure 3) involves unconsciously solving the problem. Here, a creative person is unconsciously making linkages among information and filtering occurs to facilitate the linking process. Hence, incubation is mapped to differentiating in 'information seeking' (see Table II, row 5). The rationale for this link is that while an information seeker filters information gathered, he / she may be subconsciously making linkages among the filtered information and is working towards solving the information need. Hence, there should be a link between incubation and differentiating.

- *Link #3* - Illumination happens when an idea strikes (see Figure 3). The possible information seeking behaviours that facilitate this process include monitoring developments and extracting relevant information

17

(see Table II, rows 6-7) from sources. The rationale behind this link is that monitoring developments in a field helps an information seeker address the problem or create a product by providing background information about the latest developments in a field. Hence, ensures that he / her addresses the problem uniquely or creates a unique product. Extracting is also linked to illumination because it is during extracting that the information seeker is systemically working on the information problem so that it can be addressed.

- *Link #4* – Verification in a 'creative process' (see Figure 3) involves checking the accuracy of information and working the idea into a communicable form. Thus, verification in a creative process is linked to verification and ending activities in information seeking (see Table II, rows 8-9). The rationale for this link is due to similarities between verification in the creative process and ending in information seeking. Verification in the creative process is concerned with working the idea into a communicable form. This is similar to ending because when the information need is addressed, the information seeker may likely use the information gathered to solve a problem or create a product. Hence, the process of solving, creating and gaining the new understanding may be documented in some communicable form. Moreover, verification in a creative process is also linked to verification in information seeking because checking the accuracy of information and ideas may be necessary before the idea is worked into a communicable form.

Common links identified between the 'creative process' and the 'information seeking activities' provide a basis for identifying stages in creative information seeking. Hence hereinafter, these links are renamed to describe 'stages' in a creative process for information seeking.

Using Scenarios to Refine Stages in Creative Information Seeking

A further examination of the stages established previously highlighted that many information seeking behaviours were grouped to each stage. Hence, unique characteristics of the different information seeking activities are not highlighted explicitly. For example, in Stage 1, *preparation* in the creative process was linked with *starting*, *chaining*, and *browsing* activities in information seeking. *Preparation*, *starting*, *chaining*, and *browsing* are grouped together because all are concerned with gathering information. However by grouping them in this manner, unique ways in which information is gathered in *starting*, *chaining*, and *browsing* are not highlighted clearly. Thus, the stages were refined through the use of two information seeking scenarios. These scenarios helped better relate stages in creative information seeking to the context of information seeking behaviour, thus, facilitating refinement of these stages. The two scenarios (denoted as Scenarios A and B) were selected from Theng (2002) and Blandford, Stelmaszewska and Bryan-Kinns (Blandford, 2001) respectively which reported real world occurrences of information seeking behaviour. Fictitious names have been given to the information seeker in each scenario to give the scenario more character.

Scenario A (Theng, 2002): Directed Search Task

This scenario depicts the information seeking behaviour of Peter, an experienced Web user, who was trying to accomplish a directed search task. To complete the task, Peter needs to find an article by Ben Shneiderman in NCSTRL (Networked Computer Science Technical Report Library).

In order to find the article by Ben Shneiderman, Peter typed in "Shneiderman" in the "search all bibliographic fields" and selected "sort by author". The system did not returned any results because of server problems so he reloaded the page and tried again. This time many results were returned but he could not find the article he wanted so he clicked on "Ben Shneiderman" hoping to be brought to a page with a listing of all Ben's articles. However, an error occurred which Peter thought was due to server problems. He then clicked on "search collection" in the navigation bar and typed the title to execute the search again. This time he was successful in finding the article.

Scenario B (Blandford, 2001): Open-ended, Complex Search Task

This scenario depicts the information seeking behaviour of a 1st-year PhD student, Robin. In this scenario, Robin is trying to complete an open-ended, complex search task. In order to complete the task, Robin needs to obtain at least one paper on his research topic that could help with his literature review using his choice of digital libraries from a given set.

Robin was interested in looking for materials on Growing Cell Structures (GCS), text classification and Self Organising Maps (SOM). He started by accessing the Emerald library, but switched to Ingenta, when his first few queries returned no results. Results from Ingenta were promising but overwhelming. Robin saved several abstracts and printed one full text article from Ingenta. Robin went back to Emerald library as he felt he might have made some mistakes previously. Previously, he searched Emerald library using GCS as the keyword. This time he tried searching using GCS in full text and found something. He conducted more searches using Emerald, Ingenta, and NZDL (New Zealand Digital Library), usually getting no matches or too many to cope with. At the end of his search session, he found some relevant materials on text classification but none on GCS and SOM.

Evaluating Stages in Creative Information Seeking

With the help of the two information seeking scenarios, similarities and differences between stages in the creative process and activities in information seeking become more evident. When there were similarities between stages in the creative process and activities in information seeking, a stage in creative information seeking was established. However, when no obvious similarities were found between the creative process and activities in information seeking, concepts were kept separate to form unique stages in creative information seeking.

In other words, in Stage 1, *preparation* in a creative process could only be mapped to *starting* in information seeking since both were concerned with initiating the process. *Chaining* and *browsing* in information seeking should be kept separate, as they were not specifically related to *preparation* in the creative process. They were concerned with gathering information through different means.

Evidence provided by the information seeking scenarios seemed to suggest the presence of stages in creative information seeking. Hence, mappings between the creative process and the information seeking activities were refined to establish the six stages in creative information seeking. Terminologies for these stages are from the creativity and information seeking models used, hence showing that these stages are grounded in established creativity and information seeking models.

The following paragraphs illustrate the established six stages for creative information seeking and rationale for each stage which are grounded in the new set of mappings between the creative process and information seeking activities. The new set of mappings is supported by extracts of the two scenarios presented previously. Extracts of the scenarios are presented in textboxes.

Stage 1 - Preparation for Starting Information Seeking

During this stage information seekers recognise a knowledge gap, which triggers creative information seeking. This gap needs to be addressed so

that the goal / task can be accomplished. The basis for this stage came from the following extracts of Scenarios A and B:

> Scenario A: In order find an article by Ben Shneiderman, Peter typed in "Shneiderman" in the "search all bibliographic fields" and selected "sort by author"…
>
> Scenario B: Robin was interested in looking for materials on Growing Cell Structures (GCS), text classification and Self Organising Maps (SOM)…

The above extracts show that Peter and Robin are interested in completing their task. In Peter's case, it is finding the specified article while in Robin's case it is doing some research on GCS, text classification, and SOM. However, both lacked the knowledge to complete their respective tasks which triggered their information seeking process. Hence '*preparation*' in the creative process, which is concerned with attempting to solve the information need, should be linked to '*starting*' in information seeking.

Stage 2 - Chaining Information Sources

In this stage, seekers find / track related, relevant materials to understand the breadth of a topic. The basis of this stage came from the following extract of Scenario B:

> …Robin saved several abstracts and printed one full text article from Ingenta…

Based on the above extract, it can be inferred that as Robin read the relevant abstracts and article, he may find other relevant references cited that might be useful. Hence, he undergoes chaining to get to these references. The extract also seemed to highlight that chaining is a concept

unique to information seeking as it helps the information seeker find related, relevant materials by chaining references in sources. As the creative process did not highlight any stages that have characteristics similar to chaining, chaining in information seeking could not be mapped to any stage in the creative process. However based on the extract, it was recognised that chaining is an activity that helped the seeker gathers related information to create a product or solve a problem. Hence, chaining should be included as a stage in creative information seeking.

Stage 3 - Browsing and Searching

Once information seekers have understood the breadth of a topic, they may select a focused topic and begin searching and browsing information on that topic. This stage is based on the extracts of Scenarios A and B presented below:

> Scenario A: …To find an article by Ben Shneiderman, Peter typed in "Shneiderman" in the "search all bibliographic fields" and selected "sort by author"…
>
> Scenario B: … He started by accessing the Emerald library, but switched to Ingenta, when his first few queries returned no results… Robin went back to Emerald library as he felt he might have made some mistakes previously… He conducted more searches using Emerald library, Ingenta, and NZDL (New Zealand Digital Library), usually getting no matches or too many to cope with.

In the above extract of Scenario A, Peter did a focused search as he had a clear understanding of the topic and task at hand. On the other hand, the extract of Scenario B highlights that in order for Robin to accomplish an open-ended, complex search task, he may first need to understand the breadth of the topic through chaining or some general browsing and searching before doing a focused search / browse on the topic. The extracts

also show that although browsing and searching cannot be directly linked to stages in the creative process, browsing and searching is an important activity as it helps an information seeker gathers required information so that the task can be accomplished. Hence, the extracts provide some evidence that a browsing and search stage for creative information seeking is needed.

Stage 4 - Incubation for Differentiating Purposes

At this stage information seekers are unconsciously filtering information and establishing linkages to help them form the 'big picture'. This can be a tedious task as seekers can become overwhelmed by the amount of information gathered in the previous stage. The rationale for this stage is illustrated by the following extracts of Scenarios A and B:

> Scenario A: This time many results were returned but he could not find the article he wanted so he clicked on "Ben Shneiderman" hoping to be brought to a page with a listing of all Ben's articles.
>
> Scenario B: …Results from Ingenta were promising but overwhelming…

Extracts from both scenarios seemed to indicate that Peter and Robin used their personal filtering criteria to help them cope with the overwhelming results returned by the system and also to help them determine which sources in the results' list were relevant. The extracts also highlight that incubation in the creative process is linked to differentiation in information seeking. This is because incubation involves unconsciously solving the problem and filtering may occur to help the information seeker establishes linkages towards solving the problem. Hence, based on evidence suggested

by the extracts, Stage 4, incubation for differentiating purposes, was proposed.

Stage 5 - Monitoring and Extracting for Illumination

During this stage, information seekers monitor developments in a field and go through sources to pull out relevant information so that they can achieve a personal understanding of the topic and an idea can be produced. The foundation for this stage is provided by the following extracts of Scenarios A and B:

> Scenario A: …He next clicked on "search collection" in the navigation bar and typed the title to enter the search again. This time he was successful and found the article…
>
> Scenario B: …At the end of his search session, he found some relevant materials on text classification but none on GCS and SOM…

Using the above extract of Scenario A, it can be inferred that in order for Peter to know if the source in the results' list is that one he really needs, Peter needs to explicitly access the source and look at the document to extract information to determine if it is indeed the correct one. As for the above extract of Scenario B, it can be inferred that in order for Robin to know how to complete his literature review (that is, illumination), he needs to go through relevant materials found to extract parts that are useful for him. Moreover, since a literature review is concerned with showing the progression of developments in certain concepts, Robin may also need to do some monitoring of concepts highlighted in materials that he has extracted so that his literature review is more comprehensive.

The above extracts show that illumination in the creative process should be linked to monitoring and extracting in information seeking. This is because monitoring and extracting may facilitate illumination by providing relevant information while monitoring may also facilitate illumination by ensuring that the problem is addressed uniquely and ideas created are exclusive.

Stage 6 - Verification of Information Sources

After illumination, information seekers go through a process to ensure that the idea is correct. Then seekers work the idea into a communicable form. Rationale of this stage is provided by the following extracts of Scenarios A and B:

> Scenario A: …He next clicked on "search collection" in the navigation bar and typed the title to enter the search again. This time he was successful and found the article…
>
> Scenario B: …At the end of his search session, he found some relevant materials on text classification but none on GCS and SOM…

Based on the above extract of Scenario A, it can be inferred that in order for Peter to determine if the source is the one he needs, Peter needs to access the actual source to extract information about the source. He then needs to verify the extracted information with information provided about the specified source. As for the extract of Scenario B, it shows that Robin had gathered some information on his research topic which he can use to complete his literature review (that is, working the idea into a communicable form). Moreover based on the extract, it can be inferred that Robin may conduct more searching / browsing to ensure that the information gathered is indeed accurate.

Hence, the extracts highlight that verification is the creative process can be mapped to verification and ending in information seeking because they are all concerned with verifying the information gathered and using the information gathered to accomplish the task.

Discussion and Conclusion

Evidence provided by the scenarios used to conceptualise the creative information seeking model seemed to suggest that the type of information seeking task may have an impact on the extent to which the information seeker exhibits all stages in the model. In other words, this means that if the information seeking task is directed, the information seeker may only need to exhibit minimal creativity in order to accomplish it. For example, in Scenario A where Peter was asked to find a specified article, evidence provided by the scenario seemed to show that Peter did not go through all stages in creative information seeking to complete the task. Peter did not seem to exhibit the full characteristics of Stages 2, 5, and 6. On the other hand, if the information seeking task is open-ended and complex, then the information seeker may need to exhibit more creativity so as to complete it. For example, in Scenario B where Robin was asked to find at least one article that would help in his literature review, Robin seemed to have to gone through all stages highlighted in the model to complete the task.

In order to evaluate the observation that for information seekers to accomplish an information seeking task, the type and complexity of the

task may have an impact on the extent of creative information seeking exhibited, there is a need to conduct empirical studies and gather evidence to examine this observation in more detail. Hence, Part II aims to verify and evaluate this observation through two studies. The objectives of these studies are to lend support to the six stages in the creative information seeking model and to examine the extent of creative information seeking exhibited by information seekers while accomplishing the information seeking task. One study will address these objectives using a directed search task while the other study will address similar objectives using an open-end, complex search task.

In this paper, a conceptual framework for six stages in creative information seeking has been proposed by synthesizing a holistic model of creativity and an established information seeking model. These stages differ from Wilson's model of information seeking behaviour (Wilson, 1981), Kuhlthau's model of the information search process (Kuhlthau, 1993), and the behavioural model of information seeking (Ellis, 1989; Ellis, 1993).

The six stages in creative information seeking focus on the creative and cognitive processes involved during the information seeking experience while the model of information seeking behaviour (Wilson, 1981) focuses on how information needs arise as a result of a person's needs and environment. Kuhlthau's (1993) model of the information search process, on the other hand, is concerned with the feelings, thoughts, and actions associated with each stage of the process. The behavioural model of

information seeking (Ellis, 1989; Ellis, 1993) focuses on eight generic activities in information seeking and recognises that the sequence of these activities is dependent on an information seeker's context and circumstances.

This is an on-going research. Proposed stages in a creative process for information seeking need to be further refined, tested, and used in real-world situations before they can emerge as stages and principles for the design of IR systems to support users' creative information seeking behaviours. In Part II of this paper, methodologies and analyses of two empirical studies will be presented and discussed. The aims of these studies are to lend further support to the creative information seeking model and to gather evidence to evaluate the observation that the extent of creative information seeking exhibited by an information seeker is dependant on the type and complexity of the task.

References

Akin, O. and Akin, C. (1998), "On the process of creativity in puzzles, inventions and designs", *Automation in Construction*, vol. 7, pp. 123-138.

Amabile T. M. (1990), "Within You, Without You: The Social Psychology of Creativity, and Beyond" in Runco, M. A. and Albert, R. S. (eds.), *Theories of Creativity*, Sage Publications, California.

Belkin, N. J. (2000), "Helping people find what they don't know", *Communications of the ACM*, vol. 43 no. 8, pp. 58-61.

Belkin, N. J., Oddy, R. N. and Brooks, H. (1982), "ASK for information retrieval: part I background and theory", *The Journal of Documentation*, vol. 38 no. 2, pp. 61-71.

Blandford, A., Stelmaszewska, H. and Bryan-Kinns, N. (2001), "Use of multiple digital libraries: a case study", *Proceedings of JCDL*, pp. 179-188.

Case, D. O. (2002), *Looking for Information: A Survey of Research on Information Seeking*, Elsevier Science, California.

Csikszentmihalyi, M. (1990), "The Domain of Creativity" in Runco, M. A. and Albert, R. S. (eds.), *Theories of Creativity*, Sage Publications, California.

Diakidoy, I. N. and Kanari, E. (1999), "Student teachers' beliefs about creativity", *British Educational Research Journal*, vol. 25 no. 2, pp. 225-243.

Drazin, R., Glynn, M. A. and Kazanjian, R. K. (1999), "Multilevel theorising about creativity in organisations: a sensemaking perspective", *Academic Management Review*, vol. 24 no. 2, pp. 286-307.

Edmonds, E. and Candy, L. (2002), "Creativity, art practice, and knowledge", *Communications of the ACM*, vol. 45 no. 10, pp. 91-95.

Ellis, D. (1989), "A behavioural approach to information retrieval design", *The Journal of Documentation*, vol. 45 no. 3, pp. 171-212.

Ellis, D., Cox, D. and Hall, K. (1993), "A comparison of information seeking patterns of researchers in the physical and social sciences", *The Journal of Documentation*, vol. 49 no. 4, pp. 356-369.

Fisher, G. and Nakakoji, K. (1997), "Computational environments supporting creativity in the context of lifelong learning and design", *Knowledge-Based Systems*, vol. 10, pp. 21-28.

Gabora, L. (2002), "Cognitive mechanisms underlying the creative process", *Proceedings of the Fourth Conference on Creativity and Cognition*, pp. 126-133.

Henninger, S. and Belkin, N. J. (1996), "Interface issues and interaction strategies for information retrieval systems", *Conference on Human Factors and Computing Systems*, pp. 352-533.

Kazanjian, R. K., Drazin, R. and Glynn, M. A. (2000), "Creativity and technological learning: The roles of organisation architecture and crisis in large-scale products", *Journal of Engineering and Technology Management*, vol. 17, pp. 273-298.

King, B. J. and Pope, B. (1999), "Creativity as a factor in psychological assessment and healthy psychological functioning", *Journal of Personality Assessment*, vol. 72 no. 2, pp. 200-207.

Kuhlthau, C. C. (1993), "A principle of uncertainty for information seeking", *The Journal of Documentation*, vol. 49 no. 4, pp. 339-355.

MacCrimmon, K. R. and Wagner, C. (1994), "Stimulating ideas through creativity software", *Management Science,* vol. 12 no. 11, pp. 1141-1145.

Maslow, A. H. (1959), "Creativity in Self-Actualising People" in Andersen, H. H. (ed.), *Creativity and its Cultivation*, Harper Collins, New York.

Mooney, R. L. (1963), "A Conceptual Model for Integrating Four Approaches to the Identification of Creative Talent" in Taylor, C. W. and Barron, F. (eds.), *Scientific Creativity: Its Recognition and Development*, Wiley, New York.

Rhodes, M. (1961), "An analysis of creativity", *Phi Delta Kappan*, vol. 42 no. 7, pp. 305-310.

Saunders, R. and Gero, J. S. (2002), "How to study artificial creativity", *Proceedings of the Fourth Conference on Creativity and Cognition*, pp. 80-87.

Theng, Y. L. (2002), "Information therapy in digital libraries", *Proceedings of the Fifth International Conference on Asian Digital Libraries,* pp. 452-464.

Weisberg, R. W. (1993), *Creativity Beyond the Myth of Genius*, W.H. Freeman, New York.

Wilson, T. D. (1981), "On user studies and information needs", *The Journal of Documentation,* vol. 37 no. 1, pp. 3-15.