Using Serendipity to Advance Knowledge Building Activities

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ABSTRACT: Serendipity has been shown throughout history to contribute towards creative advancements, scientific discovery and the generation of new knowledge. However, because most literature does not consider serendipitous information encounters to be typically goal-oriented, research on the use of serendipity as a recognized method of information acquisition is lacking. Building upon a review of current literature, this paper posits that the deep knowledge work and the strong social networks inherent in knowledge building environments would provide the ideal platform for fostering serendipitous insights. It is further suggested that tools to deliver potentially serendipitous content would be of value to knowledge building activities by encouraging active and creative connections to content, identifying and overcoming knowledge-gaps during moments of idleness, as well as making users more perceptive to future information encounters. Possibilities for the integration of such tools into existing knowledge building environments are then presented.

Introduction

The term "serendipity" is generally used to describe the process of making fortunate and unexpected discoveries by accident (McCay-Peet & Toms, 2010; "Serendipity", 2011; Lu, 2012). There have been many instances throughout history where serendipity has been considered an integral component of scientific discovery and creative advancement (see, for example, Bosenman, 1988; Beveridge, 1980; van Andel, 1994). For example, Bosenman (1988) emphasizes that cultivating an aptitude for serendipity could potentially improve the prospects of scientific discovery by allowing scientists to harness the interplay between the formal scientific method and chance encounters. Foster & Ford (2003) highlight the importance of serendipity in transcending disciplinary boundaries to enhance connection-building activities and the generation of new knowledge.

The process of serendipity is said to occur when an observed "trigger" stimulates a bisociation between two previously unrelated subjects, leading to the development of an unexpected solution (McCay-Peet & Toms, 2010). The solution produced through this process

may either be in response to a *sought* problem (i.e. relevant to a particular goal), or an *unsought* problem where no particular goal was identified prior to the serendipitous information encounter (McCay-Peet & Toms, 2010). This paper will focus on the former in the context of knowledge building; particularly with regards to addressing knowledge gaps and instances of idleness.

While much of the literature on serendipity emphasizes the 'surprise' or accidental nature of an information discovery (Erdelez, 1997; Williamson, 1998; Foster & Ford, 2003; Heinström, 2006), few sources emphasize the importance of prior knowledge and sagacity in formulating these bisociations (André *et al*, 2009; van Andel, 1994). In many cases, the observation of the "trigger" and the subsequent formulation of the bisociation may not occur instantaneously, requiring a period of incubation time before the serendipitous connection occurs (McCay-Peet & Toms, 2010; Lu, 2012). It has been suggested that the conditions most conducive to facilitating these serendipitous connections are 'active learning' and 'social networking'; activities that remain foremost within the context of knowledge-building environments (McCay-Peet & Toms, 2010; Stahl, 2000; Scardamalia & Bereiter, 2006).

André *et al*. (2009) and Lu (2012) present an axial classification of current serendipity literature using two metrics: *information activity* (purposeful search vs. non-directed browsing) and *relevance of information encountered* (relevant to a goal vs. not relevant to a goal). Both authors have identified that a gap in the literature exists where "unpurposeful" information retrieval activities were used to fulfill a particular goal. Lu (2012) suggests that non-directed browsing is typically not something that is goal-oriented; however, as detailed in the proceeding sections, an opportunity exists for this type of unstructured, goal-directed information acquisition as a means of advancing knowledge-building activities.

Knowledge Building and Serendipity

While "constructivist learning" is often used synonymously with "knowledge building" throughout education literature, in practice there exists a wide disparity between what one might consider "deep" constructivism versus "shallow" constructivism (Scardamalia & Bereiter, 2003). Knowledge building represents a form of deep-level constructivism, with a focus on knowledge creation leading to the emergence of new ideas and continued efforts to improve them (Scardamalia & Bereiter, 2003). Conversely, many of the so-called constructivist activities currently found in classrooms would be examples of "shallow" constructivism, with an emphasis

on assembling and compiling existing knowledge rather than actively analyzing, synthesizing or producing it (Scardamalia & Bereiter, 2003).

Unlike other forms of classroom inquiry, the purpose of knowledge building is not merely to emulate "expert" work in the field, but rather to promote advances in the state of knowledge within the immediate knowledge community (e.g. the classroom), and to then situate these advances within a broader societal context (Scardamalia & Bereiter, 2006). Knowledge advancements are sought for the purposes of idea improvement, rather than to aspire towards some 'absolute truth' or other targeted outcome (Scardamalia, 2002; Scardamalia & Bereiter, 2006). In this sense, the oft-used strategy of Google-copy-paste, common to "shallow" constructivist tasks, would be both insufficient and ineffective towards establishing the deep understandings and cognitive connections required for this type of knowledge work.

However, as Haraclitus aptly asserted in 500BC, "the unexpected connection is more powerful than one that is obvious" (Kop, 2012b). Some have argued that "nearest neighbour" searches, such as Google, are killing serendipity by excessively limiting the occurrence of encountering unexpected information (Foster & Ford, 2003). Conventional search algorithms work by requiring the user to input a set of key words or search terms, then the system produces a list of results whose representation most closely matches the query – typically with the most relevant results appearing at the top. However, while current research suggests that algorithm-driven computer applications have so far been unable to automate true serendipity, there are a number of existing tools capable of producing content that "may be perceived as serendipitous" (André *et al.*, 2009; Kop, 2012b). For example, social "discovery engines" such as StumbleUpon, BananaSlug, or the del.icio.us randomizer can foster serendipity by surfacing interesting connections and by allowing users to share their findings with their social network (André *et al.*, 2009). In the context of a knowledge building environment, I would rename such a tool an "inspiration engine."

The use of an inspiration-engine, as opposed to conventional "nearest-neighbour" searching, would be valuable to enhance knowledge building for several reasons. First, it forces learners away from the habit of passively receiving information towards actively making sense of it. Kop (2012a) suggests that the number of serendipitous occurrences will largely depend on the appropriate "distance" between the user and the information provided; if this distance is too large, the information presented will be perceived as random/irrelevant, and if the distance is too

small, the level of 'unexpectedness' decreases (Kop, 2012a). However, surfacing content within the 'Goldilocks zone of relevance' would support the growth of ideas by revealing hidden analogies and enabling creative or inspirational connections to develop between information sources (Cory, 1999; Foster & Ford, 2003).

Second, inspiration engines would provide a potential solution to moments of idleness where the current state of knowledge is at a stand-still. When trying to solve a problem, the knowledge community may recognize that there are gaps in their current knowledge base, however they may be unable to articulate what Johan Olaisen refers to as "what we don't know that we don't know" (Olaisen, 1991; Foster & Ford, 2003; Belkin, Oddy & Brooks, 1982). As Belkin, Oddy & Brooks (1982) describe,

> There are certainly occasions when one might be able to specify precisely what information is required to bring the state of knowledge to a structure adequate for resolution of the problem, but it seems obvious that the more usual situation will be that in which what is appropriate for the purpose is not known in advance. In such a situation, the best-match strategy does not seem a reasonable first choice for [information retrieval] purposes (p. 3)

Alternatively, an inspiration engine (or the less technological equivalent "free play" time – which I can attest works well through undergraduate calculus and beyond) could be purposefully implemented during such instances as a possible trigger for serendipitous insight. De Bruijn and Spence (2008) have developed a behavioural model suggesting that merely glancing at an item of interest can trigger awareness of possible solutions to a problem. André *et al*. (2009) hypothesize that users would be willing to tolerate some amount of distraction or irrelevance if there is even a minor benefit to the problem at hand; however research in this area requires further investigation.

Finally, incorporating an inspiration engine into knowledge building practices would prepare the mind to become what Erdelez (1999) terms a "super-encounterer" of information (see sidebar). According to Erdelez, super-encounterers are much more highly adept at

Types of Information Encounterers
(adapted from Erdelez, 1999)

Non-Encounterer: someone who has difficulty recalling information-encountering experiences and feels that information-encountering is something that rarely occurs

Occasional Encounterer: someone who encounters information occasionally, but doesn't regard these experiences as anything more than luck

Encounterer: someone who frequently encounters information and benefits from the experience, but doesn't regard it as a means of information retrieval

Super-Encounterer: someone who encounters information on a regular basis, and perceives it as an important and beneficial strategy for information retrieval

perceiving potentially "serendipitous" information in their environment compared to others (Erdelez, 1999). Further, super-encounterers frequently rely on identifying this type of information and benefit from such findings on a regular basis (Erdelez, 1999). However, because information encountering generally doesn't adhere to traditionally prescribed information retrieval strategies, super-encounterers have tended to be reluctant in declaring this practice as their preferred "method" for information acquisition for fear of being ridiculed (Erdelez, 1999). Perhaps this is one of the reasons why the literature gap identified previously exists; unstructured information encounters are rarely considered by 'traditionalists' to be an active, goal-directed strategy. However, I would posit that this type of activity would be valuable in the context of knowledge building environments, and that further research in this area should be pursued.

Possibilities for Knowledge Building Software

It has already been established that the ideal environment for serendipity is one in which active learning is taking place, and where social networks facilitate the sharing of curious connections with others (McCay-Peet & Toms, 2010; Bosenman, 1988). Knowledge-building platforms would therefore serve as a prime environment for fostering such serendipitous connections.

One of the challenges addressed in current research pertains to the timing with which serendipitous content should be presented to the user (McCay-Peet & Toms, 2010; Lu, 2012; Kop, 2012). André *et al*. (2009) offer two possibilities for ways by which potentially serendipitous content could be delivered. The first would occur at the time of a 'conventional' search, where potentially serendipitous results would be displayed using a less-obviously ranked view (André *et al*, 2009). As described previously, this approach may have limitations in cases where the knowledge community is unable to articulate their particular search terms or identify their specific knowledge gaps. The second method would entail an ongoing data-mining system running in the background throughout the construction of the knowledge base, and it would give users the option of navigating to a unique site containing a list of partially-relevant content (André *et al*, 2009). Under this approach, users could choose if and when to view these results – particularly during moments of idleness or when knowledge is at a stand-still (André *et al*., 2009).

The latter of these two options would seem to be the best fit for a knowledge-building platform. However, building upon the ideas of André *et al*, I would further suggest that the potentially serendipitous content should be presented singly and sequentially, controlled by the user with "next" button (reminiscent of current "discovery engines") as opposed to filling a page with a list of partially-relevant content. This 'one-at-a-time' mode of delivery would force users to enter a mini "incubation" period, during which they would have to thoughtfully consider a result's potential usefulness and/or other possible serendipitous connections before deliberately rejecting it and clicking "next."

In the early 1980s, Nicholas Belkin developed a model known as "Anomalous States of Knowledge" (ASK) that addresses an individual's inability to identify or articulate their knowledge gaps (Belkin, Oddy & Brooks, 1982). Although he was working within the confines of a "best match" retrieval system, his means of collecting data on knowledge anomalies and the philosophies behind this approach would still hold in a collective knowledge-building environment. Essentially, the user describes his/her "information problem" using an unstructured statement, typically 2-3 paragraphs long. Text analysis software then converts this statement into a visual/structural representation of the user's ASK. There is continuous feedback between the user and the system in order to refine the ASK and to produce search results that best fit the problem structure (Belkin, Oddy & Brooks, 1982).

Belkin's ASK method of information retrieval would be applicable to the development of an "inspiration engine" within a knowledge-building platform, however rather than having users describe their information problems using an unstructured statement, the notes and artifacts produced throughout the knowledge building process would instead serve as the data from which the ASK could be constructed. In this context, rather than producing "best match" results, the system would generate a repository of results that fall within the 'Goldilocks zone of relevance' to be viewed singly and sequentially at a time of the user's choosing. As new notes and artifacts are added to the knowledge base, the repository of results would shift accordingly.

CONCLUSION

This paper has examined the benefits and value of serendipity within the context of a knowledge-building environment. While serendipitous information encounters have frequently been known to generate creative insights and scientific discoveries, they are generally not

recognized as a prescribed method of goal-oriented knowledge acquisition. The possible benefits of incorporating an "inspiration engine" into a knowledge building platform have been suggested, with particular emphasis on the ability to formulate creative connections to content, to identify and overcome knowledge-gaps during moments of idleness, as well as to make users more perceptive to future information encounters. Although existing tools to facilitate the discovery of potentially serendipitous content are still relatively new, some of the possibilities for tool functionality and integration with knowledge building platforms have been presented. There exists a potential for knowledge building environments to fill the gaps in literature with regards to the use of unstructured information encounters being used to facilitate goal-oriented tasks, and there are still many opportunities for further research in this domain.

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