Innovative Thinking in Software Development

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INTRODUCTION

As we enter the third millennium, organizations have to cope with accelerating rates of change in technology and increased levels of competition on a global scale more than ever before. In order to stay competitive within this changing business environment, organizations are forced to constantly pursue new strategies to differentiate themselves from their competition, such as offering a stream of new products and services (Satzinger et al., 1999). Furthermore, there is growing recognition that an organization's capability to deal with change, improve services and quality, cut costs, develop new products, and compete in a global market will depend upon the level of creative and innovative thinking of its workforce (Covey, 1989). In short, in order to remain competitive in an era of increasing uncertainty and market globalization, organizations must constantly be creative and innovative with their products and services.

Software has been widely considered as central to all sophisticated innovations. In the age of the Internet the challenge is to identify and evaluate new ideas, processes and applications. In many of the fastest growing industries, including computer, entertainment, communications, advertising, logistics and finance, software has been the end product itself, or the highest value component in the end product. In other cases, software has been used to support value creation and innovation processes. The growing importance of software-based innovations suggests the need to improve the creative skills of IT professionals. This need, in turn, requires an appropriate response from the IT education and training sector. Moreover, IT education and training should better nurture students' creativity, so that they can be successful in their future roles as innovative professionals and business people. It is particularly important that IT students be given an opportunity to develop and apply creative and innovative skills to software processes and products.

Given the crucial importance of creativity and innovativeness for success in a knowledge economy, the main purpose of this article is to explore concepts about creativity and how they relate to software development by providing empirical research examples in IT education.

CONCEPT OF CREATIVITY

The literature offers diverse conceptual definitions of creativity. Glass (2001) argues that creativity is hard to define, hard to judge and hard to quantize. Kappel and Rubenstein (1999) reason that this is due to fact that creativity is used to describe a variety of things; that is, supporting the creativity process, the creative person or the creative product present different requirements for the definition of the creativity. Tomas (1999), for example, defines creativity in terms of an original idea. Shalley and Perry-Smith (2001) point out that it is not enough to only be original; also, appropriateness is vital in order to distinguish creative ideas from surreal ideas that may be unique, but have unlawful or highly unrealistic implications.

Central to creativity is the ability to generate ideas. Some psychologists and philosophers have argued that idea formation can be explained by way of association (Mednick & Mednick, 1964). This theory suggests that association occurs when two stimuli take place together (contiguity), when two stimuli are similar to each other (similarity), or when two stimuli are different from each other (contrast). Associations may be stimulated by environmental factors, by previous associations, or may be mediated by ideas related to other associates. Therefore, it is possible to have many combinations and permutations. Associations can vary in strength, depending on how often associated ideas occur together or separately.

Lateral thinking is an aid to creativity when one needs to have diverse ideas. It is a function of knowledge and imagination that may bring out discovery, innovation, imagination, and exploration. Lateral thinking consists of seeking as many alternative options as possible to the extent of one's adventurousness. In other words, it is a mental activity involving making connections between knowledge and ideas that were previously unrelated. The basis of lateral thinking is that since many problems require a different perspective to be solved successfully, individuals should suspend their judgment about what is relevant to a course of action.

CREATIVITY TECHNIQUES

Consistent with the view that creative thinking can be learnt by appropriate stimulation and instruction, a variety of formal techniques have been developed to assist the production of novel ideas including brainstorming, mind mapping or solo brainstorming. Brainstorming and similar idea generation techniques aim to increase the production of novel ideas. The objective is to promote creativity by appropriately managing interaction within group as well as enhancing the creative environment. The procedures involved in the following examples are not difficult and may involve "lateral thinking," where ideas are stimulated by members of the group.

Brainstorming is an idea generation technique that was conceptualized by Walt Disney in the late 1920s and then expanded by Alex Osborn (1957). The objective of brainstorming is to encourage associations. The basic assumption is that it is possible for an individual(s) to generate many ideas, provided that he or she is exposed to stimuli and has experience, knowledge, and the personal flexibility to develop various permutations and combinations, and the capacity to make correct selections. This method initially emphasizes the quantity of ideas generated, leaving the assessment of quality to a later stage. Brainstorming sessions can be conducted electronically or verbally. In electronic brainstorming systems (EBS), group members share their knowledge and ideas by sending their ideas to each other, and by viewing the ideas of other members. Ideas generated from a brainstorming session can be recorded and stored in electronic files, making them easily accessible for printing or later reference (Nunamaker et al., 1991).

Another free association technique is mind mapping. This method begins with writing down a main idea in the centre of the page, and then working outward in all directions, producing a growing and organized structure composed of key words and key images, as illustrated in Figure 1. Mind mapping therefore relies on association (and clustering) of concepts/issues. The association process underling construction of the mind map actually facilitates making connections between concepts, and hence tends to generate new ideas and associations that have not been thought of before.

An example of an individual creativity technique is solo brainstorming (SBS), originally proposed by Aurum (1997). This technique is especially suited to environments where sentential analysis is appropriate, or information sources are document-based (e.g., reports, abstracts). SBS requires the individuals to adhere to a formal protocol, where a series of documents are examined and then edited. The ultimate aim in an SBS session is to determine a sufficient set of issues. As applications of the SBS protocol have been computer-based, all issues are automatically available in electronic form for further analysis. The SBS protocol touches upon an important research issue in the area of knowledge management: whether an increase in an individual's level of domain knowledge will necessarily increase their capacity to be creative within that domain. Central to the SBS protocol is the encourage-

Figure 1. Mind mapping (Aurum & Gardiner, 2003)
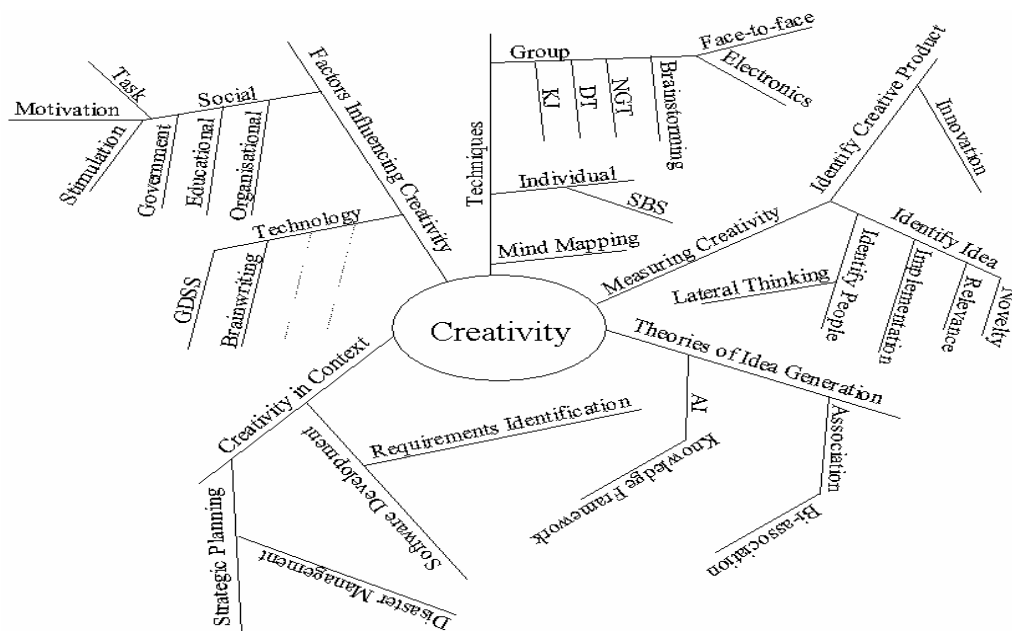
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