A Preliminary Study on The Impact of Knowledge Collection Behavior and Creative Intention on Programmer's Creativity

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ABSTRACT

Creativity is an essential ingredient in software development. The majority of existing research on creativity in software engineering addresses the requirement analysis phase. At the same time, due to the involvement of various individual and contextual factors in contemporary organizations, the complexity of the research work on creativity has increased. This has refrained researchers to venture into the creativity research in contemporary software organizations. The current research work addresses this gap and, based on componential theory of creativity and theory of planned behavior, attempts to empirically analyze the impact of two individual factors, namely knowledge collection behavior and creative intention, on programmer's creativity. The results have shown that, to perform a creative task, a programmer must intend to be creative. At the same time, knowledge collection behavior also has a positive, but moderate, impact on the intention of a programmer to be creative. The study shows the importance of a programmer's behavior towards knowledge exchange as well as his intention to be creative

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1. INTRODUCTION

Creativity is inevitably essential for the survival and growth of an organization. To remain competitive in the industry, it is important for an organization that its employees are actively engaged in creative work by producing novel ideas and solutions [1]. Creativity is a complex phenomenon and therefore the research on creativity is also challenging [2]. In creativity research on contemporary organizations, this complexity, and hence the challenge, increases because of the presence of many individual and contextual factors [3].

Software development is a creative endeavor [4] and hence software industry is considered as a creative industry [5] where the demand of creative work is relatively higher. It is impossible for a software organization to overlook creativity [6]. Therefore just like any other organization, a software organization's ability to design and innovate determines its ability to compete in the industry [5].

Recently, researchers and practitioners in software industry have emphasized the importance of creativity, however there, still, is a lack of empirical research in this domain [7]. The available research work on creativity in software engineering has mostly addressed the requirement analysis phase [8], [9], [10]. At the same time, as mentioned earlier, because of the complexity of creativity research and the presence of many individual and contextual factors in contemporary organizations, there seems to be a general lack of research work which analyzes the impact of individual and contextual factors on creativity. The current research work is an attempt to fill these gaps. Using the componential theory of creativity and theory of planned behavior, the objective of the current research work is to empirically examine the impact of two individual factors, i.e. knowledge collection behavior and creative intention, on creativity of a programmer. The upcoming section of the paper will discuss the existing literature and the resulting hypotheses.

2. LITERATURE REVIEW

This section of the paper will review the literature on knowledge collection behavior and creative intention. However before dwelling into the aforementioned individual factors, it seems imperative to shed some light on creativity in software engineering and programmer's creativity. The following sub section will address creativity in software engineering.

2.1. Creativity in Software Engineering and Programmer's Creativity

Software engineering resembles art creation [11] and hence is a creative endeavor [4]. Therefore creativity is an essential ingredient of software development [12]. It is important to study creativity to bring innovation and competitiveness in the software industry [7]. Because of the current boom in software industry, presence of freelance and offshore software development and high demands of users, there is fierce competition among software companies and consequently they have to rely on creativity to sustain their competitive position in the market. At the same time, it is quite evident that an organization's creative ability relies on the creativity of its employees.

Software development consists of several tasks where each tasks requires a different type of creativity [13]. Currently, as mentioned earlier, most of the researches in the domain of software engineer's creativity deals with requirement analysis phase [8], [9], [10].

The literature shows that after architectural design, the development phase of software engineering is considered as one of the most creative phases of software development [7], [14]. Hence, the emphasis of our research is creativity of a programmer in the development phase of software engineering. Programmers perceive programming as a creative task [14]. According to [12], in the development phase, programmers have to perform complex problem solving which requires them to be creative. In one of our papers, which has been presented in 2013 IEEE Symposium on Business, Engineering and Industrial Application (ISBEIA), Kucing, Malaysia in September, 2013, we attempted to define programmer's creativity and also specify the different and specific ways in which a programmer's creativity can manifest. Programmer's creativity can be defined as *"one's ability to develop new, surprising and valuable ideas, artefacts or outcomes of platforms, components or programs during software development"*. On the other hand, developing a new algorithm to find a solution of unfamiliar problem, using various techniques or approaches to find the solution and coding, using existing code and libraries and by merging, eliminating and modifications, generating a new piece of code or library, writing a flexible code and efficiency of his/her codes are all manifestation of programmer's creativity.

a. Knowledge Collection Behaviour

Knowledge Sharing is a *"process where individuals mutually exchange their (implicit and explicit) knowledge and jointly create new knowledge"* [15]. Knowledge sharing can be divided into knowledge donation, in which an individual shares his knowledge with other organization members, and knowledge collection, in which he collects knowledge from other organization members or explicit knowledge in the form of reports, database etc. Knowledge donation and collection is an essential part of a programmer's job [15]. The scope of the current research work is limited to knowledge collection.

Software professionals exchange valuable, complex and tacit knowledge with each other [13]. As indicated in [13], programmers interact and exchange their knowledge to not only clarify and understand the system flow but also about program syntax and logic when coding components, programming or debugging. Programmers collect knowledge from other members in the organization when they search for solutions for a problem which others have encountered in the past [13].

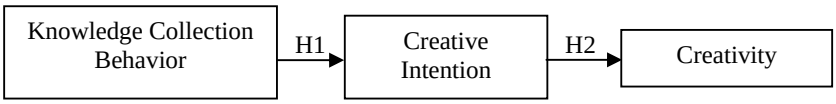
According to the componential theory of creativity and [16], domain specific knowledge is important pre requisite for creativity. Similarly, individuals create new knowledge after combining the collected knowledge with their existing knowledge [17]. Hence based on notion proposed by the componential theory of creativity and [17], we propose that through a positive knowledge collection behavior, an individual will become more knowledgeable and the process of combining his existing knowledge with the newly collected knowledge will lead to enhanced creativity. Hence it can be hypothesized that a positive knowledge collection behavior will lead to more creativity. This leads to the first hypothesis of the current research work.

H1: A positive knowledge collection behavior will lead to a positive creative intention

b. Creative Intention

According to the Theory of Planned Behavior (TPB), an individual behavior is a result of his intention towards that behavior [18]. TPB is a well-established theory to understand human behavior [19] and has been used in various research domains such as Medical science, hospitality, psychology, marketing, Islamic finance, commercial banking as well as knowledge management [20], [21], [22], [23], [24], [25], [26]. Based on TPB, we can safely posit that an individual's creativity will be preceded by his intention towards performing creative work, which is called creative intention in this research work. This creative intention will lead to an individual's actual creative behavior known as creativity. This leads to the second hypotheses of the current work.

H2: a positive creative intention will lead to a positive creativity behavior



3. METHODOLOGY

Based on the literature review, two hypotheses have been proposed in this paper. To empirically test the proposed hypotheses, personally administered questionnaire method of survey has been used to collect responses from programmers working in a GSD environment. The data was analyzed using regressions analysis in SPSS.

3.1. Measurement development

The questionnaire was developed by using the pre validated items from various studies. However items were modified to fit into the context of the current study. Five point likert scale was used for all the items. For the items to measure knowledge collection behavior, the studies of [27] and [28] have mainly been consulted. An example of the item to measure knowledge collection behavior is *"I frequently collect work reports and official documents from members of my organization", "I frequently collect knowledge from other organizational members about program syntax and logic (when coding components, programming or debugging)"*.

For the items to measure creative intention and creativity, the scale of [29] is used which is one of the briefest scales available to assess creativity by self-reporting. The examples of the items for creative intention and creativity are *"I intend to demonstrate originality in my programming assignments"* and *"I solve problems that had caused other difficulty"*.

4. PRELIMINARY RESULTS

Hypothesis 1: A positive knowledge collection behavior will lead to a positive creative intention

Table 1. Model Summary for Hypothesis 2

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Sig.
1	.461[a]	.212	.193	.57749	.002

a. Predictors: (Constant), Knowledge Collection Behavior

The above table shows a significant, positive but moderate relationship between knowledge collection behavior and creative intention of a programmer. The R value, which is .461, shows a moderate positive relationship between knowledge collection behavior and creative intention of a programmer. Through the value of R square, the table also shows that 22.1% variance in creative intention is caused by knowledge collection behavior.

The result highlight that knowledge collection behavior of an individual can, to some extent, predict his intent to perform his tasks creatively. However the correlation is neither strong nor weak, it is moderate. As mentioned in the literature review section of the paper, by acquiring new knowledge and combining it with existing knowledge, individuals create new knowledge [17]. Hence the results of the current research work comply with the literature. However the results have shown that the impact of knowledge collection behavior on creative intention is moderate. The rationale behind the moderate impact can be the nature of

impact which is indirect. The process involves combining the newly acquired knowledge with the existing one; hence the relationship of knowledge collection behavior with creative intention can be perceived as indirect. Therefore it does not have a strong impact on creative intention.

Hypothesis 2: a positive creative intention will lead to a positive creativity behavior

Table 2. Model Summary for Hypothesis 1

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Sig.
1	**.757a**	**.573**	**.562**	**.38063**	**.000**

a. Predictors: (Constant), Creative Intention

The above table shows a significant, positive and strong correlation between creative intention of a programmer and his creativity. The R value shows a very strong correlation between creative intention and creativity of a programmer. Through the value of R square, the table depicts that 57.3 % of variance in creativity is caused by creative intention. The P value which is less than .05 shows that the relationship is significant.

The strong relationship between creative intention and creativity highlight that it is important for a programmer to intent to perform his tasks creatively. The results comply with the Theory of Planned Behavior (TPB) which suggests that an individual's intention is the predictor of his / her behavior. A programmer who does not intend to perform his tasks in a creative manner will not show creativity in his job. Such a programmer will not develop a new algorithm to find a solution of unfamiliar problem, will prefer to use existing and familiar techniques or approaches to find the solution, will use existing code and libraries, will not generate a new piece of code or library, and will write inflexible and inefficient codes. Hence the results show that it is important to take into the consideration the intent of an individual while studying creativity.

5. CONCLUSION

Based on componential theory of creativity and theory of planned behavior, the current research work has attempted to fill the gap in the creativity research on programmers. Firstly, as mentioned in the earlier section of the paper, there is no study addressing programmer's creativity and some studies which attempt to analyze creativity in software engineering are mainly addressing the requirement analysis phase. Secondly, the study also fills the gap of empirically analyzing the impact of individual factors on creativity in contemporary software organization. The results presented in the study show that knowledge collection behavior of a programmer moderately affects his intention to perform a task creatively whereas the correlation between creative intention and creativity is very strong.

The results are of preliminary nature and more detailed analysis will be conducted after the data is collected from more programmers. At the same time, in future work more individual and contextual variables will be tested with creative intention and creativity of programmers.

The study will help practitioners and software houses to understand programmer's creativity and put efforts to flourish knowledge exchange behavior among the programmers. At the same time, software companies can make strategies to motivate programmers to be creative so that they intend to be creative which can lead to actual creative behavior.

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