Promoting Students' Creativity Problem Solving in Vocational Education
A Theoretical Comprehension

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ABSTRACT
Creativity is an invisible construct. It is an acceptable human capacity related to problem-solving in a social context. Distinguish between creativity and problem-solving is vague. Many studies asserted creativity and problem-solving processes are inseparable mental phenomena, and some others suggested that creativity is a part of problem-solving. In the rigidly competitive jobs world currently, creative problem-solving is a key element in achieving success. Creativity problem instruction in the classroom could provide students with authentic tasks that enhance their corresponding abilities. This article aims to probe various creativity and problem-solving-related theories and tries to propose plausible approaches to enhance the ability in vocational education.

Keywords: *Ability, Creativity, Problem-Solving, Vocational Education.*

1. CREATIVITY INTRODUCTION

research can be traced back to Gilford's American Psychological Association Presidential Address in 1959 [1]. He indicated that creative act is an example of learning. He also wonders why there is so little tie between creativity and vocational education which derive from the current problem in education as to how vocational education incubate creative individual [2]. Despite the scarcity of creative genius, at least individuals process a certain amount of creativity, these creativities are used to solve problems [3]. The educational system in vocational education can serve as the facilitator to evoke the maximum personal creative potential to solve the problems students may face either in their current situation or in the future [4].

Creativity problem solving could be especially process important in vocational education because students who attend vocational education programs may serve in either education-related institutions or education enterprise organizations. If it is the former, delivering knowledge or skills during instructional settings that could enhance students' creativity problem solving will be a concern. If it is the latter, how to generate a creative solution for the problem that the enterprise commits is essential. Since creativity has been recognized as one key element for enterprise survival in the highly competitive industry or general society environment, the enterprise's fate could be determined partly by an employee's creativity [5]. Therefore, the employees' creativity is becoming more and more important to determine the success in highly cutthroat marketplace [6].

In order to give a broad concept map to address the important of enhancing creative problem solving in vocational education, the article is written to probe various creativity and problem-solving related theories and tries to propose plausible approaches to enhance the ability in vocational education. It will start with the construct of creativity and problem-solving process. Second, come studied and theories regarding to instructional issues that have been verified useful will be explained not only how they are effective bur also try to dig the reasons why they are successful. The last step, the new trends and theories regarding to creative problem solving will be introduced.

2. CONSTRUCT OF CREATIVITY AND PROBLEM-SOLVING PROCESS

It is not easy to give a thoroughly definition of creativity because it can be described from difference angles. One most common explanation is to connect

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creativity with problem solving. To be creative, the thought one comes up mush be novel and useful [7]. Therefore, using insight to solve some problems becomes a popular operational definition of creativity [8].

An early as 1960s, Guildford had built his own "structure of intellect" based on problem-solving led by creative thinking [9]. He and his colleagues also try to understand human mind by using creative problem solving from developing his model. In this structure of intellect model, he lays out five mental operation types which are the central them of creative problem solving. They are: (1) Cognition, (2) Memory, (3) Convergent thinking, (4) Divergent thinking, and (5) Evaluation [10]. He believed two types of thinking styles play important roles in creative thinking solving. The divergent thinking is to spawn lots ideas while convergent thinking is to filter out which ideas are potentially useful in problem solving [11].

Divergent thinking and convergent thinking work together to from effective thinking which is the product of creative thinking. Inspired by Guildford's idea, many researchers start to explore creativity from problem solving perspective [12]. De Bono proposes his ideas in lateral thinking and vertical thinking to seek their relations with creativity and problem solving [12]. He concludes that vertical thinking deal with problem digging from low level to high level of the problem property and go back and forth while lateral thinking uses another way to look at the problem which may be synchronized with vertical thinking when handling the same problem. He further verifies that lateral thinking is an essential element of divergent thinking.

De Bono also directs the development of Cognitive Research Trust Program which regards "thinking" as a basic ability and it could be taught through direct instruction [13]. It was proved to be helpful in enhancing thinking skills in both learning disable children and normal adult [14]. Other study, American Psychological Association shows it will promote creative thinking skills from undergraduate math [15]. Thus, Cognitive Research Trust Program could be effective if it implies in vocational education in both high school level and college level.

3. ENHANCING CREATIVE PROBLEM SOLVING

Other young researchers think that "mindfulness" bonds with vertical thinking and lateral thinking toward creative problem-solving [16]. Chiesa, Serretti, and Jakobsen conclude that mindfulness has three properties: (1) top-down deduction, (2) bottom-up deduction, and (3) sideway learning [17]. The first two properties go hand in hand with vertical thinking and the third property is similar to lateral thinking. They believe that problem-solving should not be a simple top-down or bottom-up process.

Sometimes, it also uses an alternative way, involving sideway learning to offer cues toward problem-solving. Previous studies try to reformulate the traditional logical thinking model about thinking [18]. The sideway learning as an alternative way for problem solving offers new perspectives looking into problems and prevent from the occurrence of short in thinking process [19]. This change of thinking is about thinking incorporate with Sternberg's componential theory [20]. Three components are in Sternberg's theory: (1) knowledge acquisition, (2) higher order processes of monitoring, planning, and decision making, and (3) a performance component that process tasks [21].

However, Sternberg's component theory cannot explain the whole story of creative problem solving. It is simply a part of so-called domain-individual-field interaction (DIVI) model [22]. The knowledge acquisition is only a part of mind. To own knowledge and know how to operate knowledge we have to solve problem based on the right time, place, and content required another capacity to interact with the environment. This concept leads to the birth of DIVI model which is a biopsy social approach in problem solving [23]. The DIVI model looks very reasonable from individual perspective. As a traditional process of problem solving, human being may be short of resources to put multiple views of a problem at the first step. What usually do first is to check back existing knowledge-base from individual perspective; however, it may not meet the need of creative problem solving without the reference of the domain rules and the judgment of the field.

Therefore, Csikszentmihalyi take ideas from famous inventor Rabinow about three elements in creative problem solving: (1) persistence to new ideas, (2) a large knowledge base, and (3) good judgments [24]. When each of the element comes congruent with other two elements in DIFI system, it reaches an optimal state called "flow", such as peak experience". Flow is positive internal regard. It is a reward for achieving a challenging goal required highly demand of either thinking or performance skills.

The creativity will come out between challenge and skills [25]. Once an individual internalizes the DIFI system, he or she will develop an authentic area that allows ideas to come to blows and cooperate mutually to generalize useful creative products [26]. The internal creativity generation process is also dynamic in the DIFI system. Csikszentmihalyi stated that creativity results from the interaction of a system composed of three elements: a culture that contains symbolic roles, a person who brings novelty into the symbol domain, and a field exert who recognizes and validates the innovation All three are necessary for creative idea, product, or

discovery to take place [27]. His view further confirmed the DIFI systems role in creative problem solving.

Back to study from Csikszentmihalyi and Rathundes, they indicate that flow can be the balance state of boredom and anxiety [28]. They use seven dyad contrast character for boredom and anxiety. Divergent thinkers will experience flow when they reach the balance state of these seven complex dyads regardless what actin they take. Although creativity intrigues with problem solving, it still bends with originality, fluency, flexibility, and collaboration. But, how do these elements develop? Once reveal this problem, the development of creativity will be understood.

The development of creativity is also multi-directional. Feldman claims that in order to understand the development of creativity, it requires to explore seven dimensions to obtain adequate information [29]. The dimensions are cognitive process, social or emotional process, family, education or preparation, domain and field, social/cultural influences and historical influences. In early childhood stage, cognitive process and family should be outweighed to other dimensions in creativity development. In the early twentieth century, most researchers think creativity ability in mostly inherited. However, genetic factors can only be factors of creativity development. It is insufficient to tell the whole story. Creativity also requires supportive environment to stimulate [30]. Simonton argues that there are large number of infants are born a day; however, only less than 0.1 present will be revealed that they have creativity potential [31]. If there are no appropriate environment, creativity will not develop and the potential will waste. For the young children, the most influential environment in their creativity development is family.

People with high level of achievement in some professional fields, such as music, medical service, or math have family who story awe related to these professional fields [32]. Children in such family environment tend to be advantageous in the fields and increase the likelihood that children will be succeed in these related areas. This interprets the impact of family in one's own intellectual development. Some other studies explore that family culture, birth order and traumatic experience about family members will influence one's creativity development [33].

One study by Amabile (1996) finds creative people live un a special way comparing with normal families. Dacey and Lemnon compiles main ideas of Amabile's study [22]. They concluded that parenting style and home atmosphere are more important tant genetic factors in creativity development. The results also point out that six critical periods for an individual to build their self-image. If one is encouraged to do something in one of the six critical moments, it will affect this individual's willingness to take risk on their thought. The first five years after birth is the first critical stage. In a creative family offers more opportunities for this and show positive attitude to what children did. These families take a more open attitude toward children's behaviour which may encourage the development of creativity. Further, parent in creative families will note rate high IQ or good school GPA as a very important trait. They value more on imagination and honesty [34]. Other that family, creativity development also bonds to schooling or education.

Most studies process conservative attitudes toward school's enhancement of creativity in early years of development. Some researchers, such as Einstein felt school may hinder creativity development. Although Darwin processes positive function to school for creativity enhancement, it is because school offers a good academic environment rather than school will promote creativity in some fields [35]. When young children attend school, most of them will become more caution and less innovative ideas will not come out[36]. One of the possible reasons for this is that most school system use seated learning [37]. Teachers most use language to teach students. Students passively receive the knowledge delivery. They lost the active learning role school and become a spectacular. Further, student innovative behaviour may be suppressed by peers. They would not like to take risk to be away from the general public. They do not want to be labelled as acentric [38]. Teachers also are less willing to apply creative instructional actions because it is also too risking and may lose control of the class [39].

But not all studies will agree that school have no functions for creative development in early age. School may be helpful for creativity when children grow to adolescent stage [40] and school will be more helpful in developing creativity in science that other field because learning science required experience mentors to guide to reach the best result. Gardner also discovers that when peers worked together it could be beneficial in creating a new theory [41], paradigm approach because peer brainstorming offers a good opportunity to catalyse the new innovations. This is opposite to the view when an individual competes with peers may hinder creativity. A cooperation or collaboration can enhance creativity.

In the instructional side, the way traditional instruction teacher needs a little adjustment to help young children's creative development. Despite what instructional method employed in classroom, the best way to make students more creativity freedom. One best way to push creativity freedom is to give more rooms of autonomy. Once children perceive the autonomy, they performance in creativity will be greatly enhanced [42]. In other words, how much self-determination a child will control will motivate their creativity development [43]. Since school instruction can be helpful in creative development in some ways, vocational education can

definitely from school program once they are under carefully planned.

It is suggested that creativity in the classroom can predict the future success of a student in a fast change job world [44]. Moreover, there are few people born as creative geniuses. Creativity should be elicited by other ways. Creativity elicits friendly environment, like classroom [45]. Researchers suggest many strategies to teach creativity in a classroom: (1) Value and respect students' creativity, (2) teacher should focus on internal reward, (3) focus on students' mastery area, (4) give students more control over their creative thinking, and (5) promote students' motivation in class learning.

Creativity will be hindered when goal was emphasized rather than task itself. Lubart and Sternberg discover that there is an inverse-U relationship between motivation and creativity [46]. When one person has very high motivation, he or she tends to focus too much on the goal and creativity decreases. On the other hand, if one wants to be creative but lacks strong desire to maintain whole required work, he or she will not be very creative. Therefore, creativity researchers are in favour of internal motivation to external motivation that can foster creativity. Although on if recent study claims that reward, which is a reinforcer of external motivation, could increase creativity [47]. It is under the promise that there is positive relationship between creativity and reward.

4. NEW TRENDS IN CREATIVE PROBLEM SOLVING

There are any new thoughts about creative problem research. One of most prominent among this is how to access creative problem solving. In vocational education, authentic assessment is very important. The task-specific assessment of creativity, may not be very reliable and lacks criterion to compare to other task specific or cross task domain assessment. Moreover, it is still never easy to assess traditional creativity construct, such as fluency, originality, flexibility in different cultural definition. Such criterion problems still have paralyzed psychometric measurement of creativity for 30 years [48]. Further, the social science research paradigm in postmodernism nature of quantitative studies also questions the generalizability of creativity assessment.

With the advancement of many new theories, the traditional creativity theory cannot explain or remedy many current problems. For example, in a vocational education setting, fostering students' creative problem solving should focus not only on how to apply traditional creativity theory team up with instructional methods but also should consider student background and other objective environment that can serve as an assistant tool, such as technology, to foster students creative problem-solving ability.

There are two approaches to comprehensive creative problem solving. One of them starts to examine the relationship between the society, biology, evolution, and creativity and formulate new look of creativity which is called biopsychosocial explanation of creativity, such as Dacey-Lennon model. We expected such model could become the mainstream model of creativity because it integrated biological, personality, cognitive, and social categories. It could follow social dynamic and collect these changes and, in turn, reflect the evolution of creative behaviour.

The other aspects of study, researchers have brought recent development of psychological construct, such as cognition, to re-examine the relationship with creative activity [49]. For example, this can be done through the ability to think creatively with four aspects: fluency, flexibility, originality, and elaboration [50]. OECD mentioned that for the purposes of the creative problem-solving assessment, the processes involved in problem solving can be grouped becoming four: (1) exploring and understanding, (2) representing and formulating, (3) planning and executing, and (4) monitoring and reflecting [51].

Exploring and understanding is to build mental representations of each of the pieces of information presented in the problem [52]. This involves exploring the problem situation: observing it; interacting with it; searching for information; finding limitations or obstacles; and understanding given information and information discovered while interacting with the problem situation; demonstrating understanding of relevant concepts[51].

Representing and formulating is to build a coherent mental representation of the problem situation (i.e., a situation model or a problem model) [53] [54]. To do this, relevant information must be selected, mentally organised, and integrated with relevant prior knowledge. This may involve: representing the problem by constructing tabular, graphical, symbolic or verbal representations, and shifting between representational formats; and formulating hypotheses by identifying the relevant factors in the problem and their interrelationships; organising and critically evaluating information [51].

Planning and executing include planning, which consists of goal setting [55], including clarifying the overall goal, and setting sub-goals, where necessary; and devising a plan or strategy to reach the goal state, including the steps to be undertaken; and executing, which consists of carrying out a plan. Monitoring and reflecting includes monitoring progress towards the goal at each stage, including checking intermediate and final results, detecting unexpected events, and taking remedial action when required; and reflecting on solutions from different perspectives; critically evaluating assumptions

and alternative solutions; and looking for additional information or clarification [51].

Hopefully, these new approaches can bring a new look for creative theory. Further, the aid of modern tools, such as technology, paired with power to these newly developing theories could give us more clear methods of fostering creative problem-solving ability.

5. CONCLUSION

Increasing creativity in solving problems for students of vocational educational needs to be considered and implemented clearly in vocational education. This needs to be done by educational institutions because the success factor for vocational education graduates is not only determined by technical ability but this is also determined by creativity in solving problems in the workplace as a personal ability. This ability will familiarize workers with being able to adapt to changes in their environment in the era of the industrial revolution 4.0 and today's society 5.0.

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