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Learner's Creative Thinking of Learners Learning with Constructivist Web-Based Learning Environment Model: Integration between Pedagogy and Neuroscience

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Abstract: The Purposes of this research were: 1) to examine learners' creative thinking 2) to compare pretest and posttest of the learners' creative thinking for measuring and evaluation of executive function by using Torrance Tests of Creative Thinking (TTCT). The Model research Phase III Model Use was employed in this study. Both quantitative and qualitative data were collected and analyzed. Mean, standard deviation, percentage and Z test, Wilcoxon Matched-pairs Signed rank test and protocol analysis were used to analyzed the data. The target group was 24 learners of the 2015 academic year at Srisemawittayaserm School. The results showed that: 1) The students' creative thinking 4 aspects including: (1) fluency (2) flexibility (3) originality and (4) elaboration and 2) The comparison of the pretest and posttest of the learners' creative thinking, from measuring and evaluation of executive function by using Torrance Tests of Creative Thinking showed that standard scores total activity of posttest all students were significantly higher than standard scores total activity of pretest at the level 0.05.

Keywords: Constructivist, Web-based learning environment, Neuroscience, Creative thinking

Introduction

Regards the society development which driven by knowledge, human resource development in terms of creativity and innovation is very challenge to the education revolution due to make a preparation for the working environment under the new trend of economy. It is very urgent to develop and foster the efficiency of the Thai among the fast moving of economic world which requires the human to be skillful in science, math, and creative thinking to be able to confront and solve a problem effectively, which consistent with the learning in 21st century about the Creativity and Innovation development. Including the Eleventh National Economic and Social Development Plan 2012-2016 (Office of the National Economics and Social Development Board, 2011) which focuses on creative thinking (Drucker,1993; Sawyer,2006; Charoenwongsak, 2004). The creative thinking is higher-order thinking, the ability to think or find a solution in multiple ways by connecting the prior knowledge with the new knowledge into a new work or production or to solve a new problem (Samat, 2015). Therefore the creative thinking is not only the ability to use in learning, but it can be used to solve a problem in different situation (Hardiman, 2010; Rotherham & Willingham, 2009).

The current learning paradigm has been shifting from "teaching" to "learning" which most importantly focuses on the learners. In addition, the development then could be enhanced by using information technology for life-long learning. Furthermore, the unreachable of achievement in basic education school management according to the national standard. This might cause from the lack of learner-centered and thinking enhancement especially in analytical, critical, and creative thinking.

One of the learner development for such mentioned enhancement according the national education plan is to design the instruction based on pedagogy as Cognitivism which foster the learners to create and have their own cognitive process, Constructivist which mainly on knowledge construction along with creative thinking in area of information and technology consistent with learning 21st century. Especially in task presentation by using information and technology which requires the originality and presentation in more multiple ways fluently and quickly. This corresponds to the creative thinking (Guildford, 1967): fluency, flexibility, originality, and elaboration.

Moreover, the study of recent studies was found that the results mainly showed creative thinking in cognitive process based on learning theory, but insufficient for the study of what happen in cognitive process of the learners. Therefore, the integration of Pedagogy and Neuroscience in terms of methods and equipment was focused in this study. Qualitative and quantitative data collection with biomarker can show the empirical evidence of its cognitive process. The study of creative thinking by evaluating of executive function along with protocol analysis based on Guildford (1967) is one of the study that integration Pedagogy and Neuroscience. Designing the constructivist web- based learning environment and creative thinking according to Cognitive theories and Cognitive neuroscience. This kind of study is not the study of behavior observation but it is the enhancement of learner's cognitive process to help them to be able to construct knowledge and confront the authentic problem in real life situation. The knowledge construction is enhanced by the connecting of prior and new knowledge through schema along with media attributes and media symbol system by each learner's processing ability affected to their learning ability (Kozma, 1991; Chaijaroen, 2008). The web-based learning with hyperlink, hypertext, and hypermedia can help the learners to construct knowledge as each node of knowledge connection can link more and more. This can help the learners elaborate knowledge by their own selves.

As mentioned above, the researchers hence realize the importance of the design and development of the constructivist web-based learning environment to enhance Creative thinking, and intend to study the Creative thinking of the learners. The finding finally may beneficial to enhance the learners to have more creative thinking and learning efficiency. Furthermore, the integration of neuroscience of methods and equipment could showed the empirical evidence of cognitive process. Such results so could be used to develop the human resource and 21st learning century for the stability of knowledge and economic society.

Research purposes

2.1. To study the creative thinking of the learners who learned with the Constructivist.

2.2. To compare the pretest and posttest of the creative thinking between before and after learning with the environment by evaluating the executive function through Torrance Tests of Creative Thinking (TTCT).

Research methodology

3.1. The target group was 24 learners of the 2015 academic year at Srisemawittayaserm School

*3.2. The Model research Phase III Model Use (Richey & Klein**, 2007)** was employed.*

3.3. The research instruments used in the experiment and collecting data comprised of 1) the Constructivist web-based learning environment model to enhance creative thinking on the topic of Presentation 2) of the learners' interview on creative thinking and Torrance tests of Creative Thinking; TTCT).

Data collection

The data were collected as following these steps:

- Administration Torrance Tests of Creative Thinking (TTCT) to the learners before they learned with the learning environment.
- Divide the students into eight groups, each group consisted of three learners and allowed them learning with the learning environment by starting to provide a introducing them about how to learn with the learning environment in order to provoke them to get preparation and concentration to learn.
- They learned with the learning environment and completed the tasks to enhance creative thinking by using 8 components as 1) Problem base, 2) Knowledge bank, 3) Cognitive tools, 4) Creative thinking enhancement room, 5) Collaborative room, 6) Coaching, 7) Related cases, and 8) Scaffolding. Then, the researcher summarized the lesson together with them in the end of the class.
- The learners took the TTCT after learned with the learning environment.
- The students were interviewed their creative thinking by the researcher.

Data analysis

The quantitative and qualitative data were analyzed as the following:

- The creative thinking of the students was analyzed by protocol analysis based on the framework of Guilford (1967), summarization, interpretation and analytical description.
- The creative thinking of the students from the evaluation of executive function by using TTCT was analyzed by using descriptive statistics which were mean, standard deviation (S.D.), percentage and Z test, Wilcoxon Matched-pairs Signed rank test.

Research result

The results of the learners' creative thinking who learned with Constructivist web-based learning environment were as follows:

6.1. Creative thinking of the learners

The results of interview and protocol analysis were found that the learners' creative thinking who learned with Constructivist web-based learning environment on the topic of Presentation consisted of 4 aspects: **(1) Fluency** which were Word fluency and Associational fluency, it showed the students' ability to find the answer quickly by naming of 24 presentation patterns in limited time of 1 minute and comparing the **advantages of publications media** as convenient to use and distribute, the **disadvantages of such media** as no sound and unable to present animation and picture like video, to suddenly edit work, and waste of papers, advantages of electronic files as able to present animation picture as video, sound effect, make more interesting, and fast edit, and disadvantages of such files as cots a lot of investment if have no background or expertise in technology also difficult to present if have no computer or specific program to open the files or resolve virus problems; **(2) Flexibility** was the ability to create multiple concepts by be flexible to adapt or adjust presentation styles such as in project or exhibition or presented through a software as Word, Photoshop, e-book, video or web site **(3) Originality** was the ability to use the knowledge to create a concept that new, originate, and different from the previous concepts which they designed and created the presentation from the provided pictures, and it was found that they presented in exhibition pattern by stimulating places or objects and **(4) Elaboration** was the ability to elaborate the main concepts until completion which they added an idea to their presentation of The 12 value by summarizing the each main idea, adding cartoons, effects, videos, or music to make more understating to its details which such result consistent with Creative thinking framework of Guilford (1967).

6.2. The pretest and posttest of Learners' creative thinking from measuring and evaluation of executive function by using Torrance Tests of Creative Thinking (TTCT)

Table1-2 The pretest and posttest of learners' creative thinking from measuring and evaluation of executive function by using Torrance Tests of Creative Thinking (TTCT) Form A: Shape and A: Language.

Table1 The pretest and posttest of Learners' creative thinking A: Shape

Creativity Dimension	Type A)Shape(	
	Pre-test Score Total Activity (Acvt.1-3)	Post-test Score Total Activity (Acvt1-3)
	89.83	105.12
	102.15	102.29
Abstractness of titles	90.32	93.57
Resistance to premature closing	84.15	93.23
	78.09	84.82
	88.91	95.81

* Significance at the level 0.05

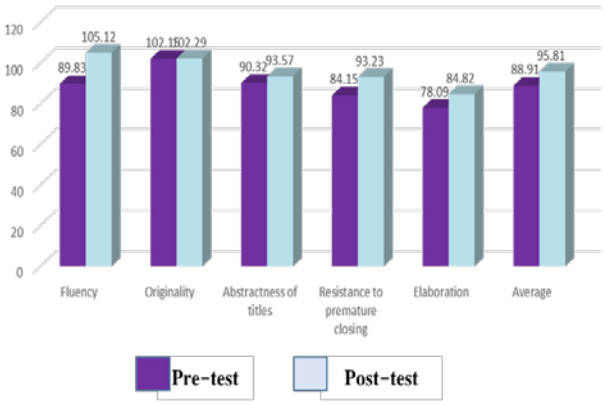

Figure 1. Comparing results of learners' creative thinking of their executive function by TTCT: Set A Shape

Table 2 The pretest and posttest of learners' creative thinking Form A: Language

Creativity Dimension	Type A)Language(	
	Pre-test Score Total Activity (Acvt.1-3)	Post-test Score Total Activity (Acvt. 1-3)
Fluency	78.65	89.42
Originality	70.21	83.01
Flexibility	84.29	88.59
Average	77.72	87.01

* Significance at the level 0.05

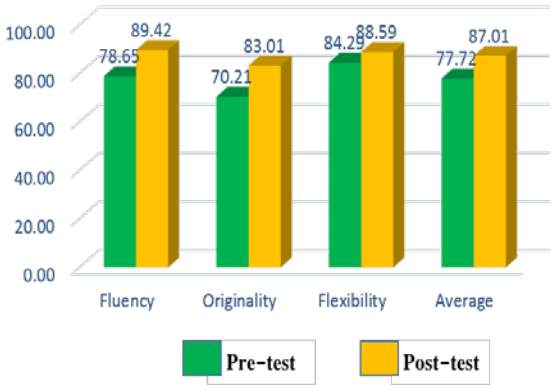

Figure 2. Comparing results of learners' creative thinking of their executive

The students' creative thinking scores from TTCT: Form A: Shape showed the posttest scores (95.81) higher than pretest score (88.91) and scores of students' creative thinking from TTCT: Form A: Language showed the posttest (87.01) higher than pretest score (77.72) significantly at the level of .05 which means they have more efficiency on creative thinking.

Discussion

7.1. Learner's creative thinking.

It was found that the students had the creative thinking from protocol analysis which were Fluency, Flexibility, Originality and Elaboration. This finding was consistent with the studies of Ditcharoen (2013); Samat (2009); Teerawat. (2007); Sujamnong (2015); Chaijareon, Samat, Kanjug. (2012), Samat&Chaijareon, (2015) which found that the learners have the ability to think creatively as fluency, flexibility, originality and elaboration , also able to expand and extend the idea outside the scope. The results of this study might cause from the design which based on theoretical principles in both Constructivist that focus on constructing knowledge and Cognitivism theory that focuses on the learning process, especially in Guilford (1967) creative thinking framework. The design was provided for the learners to have an opportunity to develop their cognitive processes though creative learning tasks as in the Creative thinking enhancing room where they could thinking creatively as the empirical evidence showed that "The Creative thinking enhancing room was fun and if I could think fluently because it had limited time and also I could understand more after doing exercise" or "Flexibility room makes us to find something new to replace the old one, or to the new program to replace Power point program such as Proshow Gold, Prezi, Powtoon " or "Originality room enhanced us to think based on our experiences in daily life and applied to a new thing to attract audiences and make more interesting" and "Elaboration room helped us to expand my ideas from my old one and can be create a new thing and have expand more ideas." Such findings consistent with the Creative thinking of Guildford (1967) which its 4 aspects emphasize on connecting to prior knowledge to create a new idea or solution.

7.2. The comparison of learners' creative thinking from the evaluation of executive function by using Torrance Tests of Creative Thinking (TTCT) before and after learning.

The results revealed that the posttest scores were higher than pretest scores from the evaluation of executive function by using Torrance Tests of Creative Thinking Form: A Shape and Language. This showed that the learners developed their creative thinking which consistent with the studies of Srikampha (2007); Kamin (2002); Kelley(1983) who studied the development of creative thinking. They found that the sample group had more creative thinking consistent with Clapham (1997) who studies the thinking skills practicing in creative thinking program and Hafizoah Kassim (2013) to study about the relationship between learning style, creative thinking to work effectively, and learning multimedia which found the enhancement of training or learning management and the benefits of using learning tools. This showed that the learning that conducted the evaluation and used TTCT hence was the learning with Cognitive activity and effected from Brain activity. This evidence showed the relationship between brain area and creative thinking activity that there are many areas are provoked by learning (Wiggins & Bhattacharya, 2014; Dietrich, 2007). Also, the study of fMRI which about the thinking sharing from confronting and provoking, it shows the results of creative thinking evoking in Temporo-parietal and Frontal area which then more creative thinking (Andreas Fink et al., 2010). Moreover, the study of creative thinking from the analysis of Cortex difference during activity through brain wave and solving problem tasks, it was found that Frontal area was efficiently in creative thinking examination (A.R.Aghababyan,V.G.Grigoryan, A.Yu.et.al., 2005). Regards these studies, the learning with the Constructivist web-based learning environment to enhance creative thinking could hence enhanced the learners' creative thinking by the evaluation of executive function directly to learning development, for example; reading for comprehension or integration with new information to understand the learning content. Executive function is the thinking process in Frontal area which work as CEO to input data and analyze, synthesize, and solve a problem before output and protect to react automatically by realizing, considering, and adjusting thoughts in order to reach success (Naunchan Jutapakdeekul, 2015)

Recommendations

The further study should be studied about other factors such as gender, age, emotions affected creative thinking in order to develop a Constructivist web-based learning environment, media attribute affected creative thinking for using such attributes to design and develop the web-based learning environment more efficiently and brain wave or specific brain area affected learners' creative thinking for more useful in development and enhancement of learners.

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