# Effects of Web-Based Creative Thinking Teaching on Students' Creativity and Learning Outcome

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The development of the Internet and communication technology has revolutionarily changed the education contents and methods. Various governments and people with vision have promoted education to the highlight to determine the future of citizens in a nation.A teacher has to develop more creative teaching methods to teach new-generation students. Past research proved that cultivating students' creative thinking could significantly affect students' creativity and learning achievement. The approach of web-based era revolutionarily changed the media of creative thinking teaching. Applying design of experiment to the quasi-experimental research, total 186 universities and collegestudents in Taiwan are preceded a 4-month teaching program in this study. The research findings show 1.positively remarkable effects of web-based creative thinking teaching on creativity, 2.positively notable effects of creativity on learning outcome, and 3.positively significant effects of web-based creative thinking teaching on learning outcome. At the end, suggestions for teachers' teaching methods are proposed, expecting to make up the theories related to web-based creative thinking teaching.

*Keywords*: web-based instruction, creative thinking teaching, creativity, learning outcome

## INTRODUCTION

Information technology is rapidly developed in the 21st century, and innovative thinking, problem solving, or critical thinking ability is the critically preliminary ability of world citizens in diversified societies. Human resource development in past years therefore stresses on the promotion of creative thinking ability, as "brain" will substitute "strength" in the knowledge economic era with fiercely international competition. To construct a creative kingdom matching with the knowledge

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economic era, an important goal of education is to have children learn knowledge and apply such learned knowledge to life. Schools are the key in the execution. Centered on the innovative learning environments and active teaching climate to create multiple teaching environments in which differences are respected and creation is appreciated, creative space and climate could be gradually formed on campus.

The skills and knowledge required for future talents are far beyond the boundary of a single subject; professional techniques, integration, communication, ethics, independent learning, and teamwork are covered, and creative thinking ability is mostly emphasized.

Past research proved the positive effects of creativity on learning outcome (Sung & Hwang, 2013); besides, several studies also discussed the effects of creative thinking teaching on the promotion of learning creativity and learning outcome (Wang, Wang &Shee, 2007). As a result, it has become a trend for a teacher changing conventional education and attracting students' attention and keeping students' learning continuity by innovative and creative teaching methods. When information technology and the Internet are thrived, the utilization of web-based platforms for creative thinking teaching becomes popular. This study aims to discuss the effects of web-based creative thinking teaching on the promotion of leaners' creativity and learning outcome so as to make up inadequate theories.

### State of the literature

- To construct a creative kingdom matching with the knowledge economic era, an important goal of education is to have children learn knowledge and apply such learned knowledge to life. Schools are the key in the execution.
- Web-based creative thinking teaching could enhance students' creativity in solving problems.
- This study aims to discuss the effects of web-based creative thinking teaching on the promotion of leaner's' creativity and learning outcome so as to make up inadequate theories.

### Contribution of this paper to the literature

- Curriculum design: Creative thinking teaching indeed could stimulate students' creative thinking ability to think of many innovative ideas.
- Curriculum practice: It is suggested to break conventional lecturing and apply grouping model so that team members with different backgrounds could break original learning climate, create innovative climate, and induce new flare from heterogeneous cooperation.
- Curriculum time distribution: It requires time to brew creative thinking. When processing the curriculum, students should be given more time for thinking or brainstorming so that the students in each group could thoroughly discuss and stimulate new ideas.

## LITERATURE REVIEW AND HYPOTHESIS

### Web-based instruction

Belanger et al. (2011) indicated that the progress of information technology and the boom of the Internet have web-based instruction become the latest distance learning method. The so-called conventional education refers to teaching activities proceeded on campus or in classrooms, where instructors and leaners are usually in the same space and leaners in a classroom have to obey certain behavioral rules and communication styles due to the environment (Lara et al., 2014). Compared to conventional education, web-based instruction used to be defined as a distance learning system set up with computers and was divided into synchronous and asynchronous systems. Asynchronous web-based instruction referred to teaching and learning processes not being preceded at the same time, teaching situations being continuously enhanced the quality through instructional design, teaching activities being controllable, and leaners being able to access to the systems for learning at any time (Jones & Sallis, 2013). In this case, web-based instruction could be briefly described as the learning method applying the Internet to deliver and acquire learning information and contents, including information technology, delivery of various material contents, accumulation and management of learning experiences, learning communities, and material designers, providers, and field

experts (Cheung et al., 2011). Harasim (2012) quoted the definition of e-learning from ASTD (American Society for Training & Development), which specifically studies learning and training, as anything delivered, facilitated, or mediated through electronic technology in order to achieve definite learning objectives. Accordingly, web-based instruction is a kind of virtual classroom distance learning, in which the Internet platform is used for teaching knowledge and skills and delivering materials to leaners through systematic material design. On the other hand, leaners could precede two-way communication and interaction with other leaners through the communication channels on the Internet. Huang et al. (2012) proposed that the real benefit of web-based instruction was to get rid of classrooms and try to teach with timeless transmissibility and interactivity. In short, e-learning is to utilize personal electronic devices and the Internet for delivering and transmitting training material contents as well as managing learning processes at any time or places.

## Web-based creative thinking teaching

Irwin et al. (2012) regarded creative teaching as encouraging a teacher changing the teaching methods whenever necessary. Liu et al. (2011) defined web-based creative teaching as utilizing web-based development and applying novel, original, or inventive teaching methods. Crooks et al. (2012) mentioned that web-based creative teaching was a teacher designing teaching activities through web-based curriculum contents to induce students' creation behaviors, i.e. allowing students applying the imagination to cultivate the sensitive, fluent, flexible, unique, and elaborative thinking abilities. Padilla-Meléndez et al. (2013) referred web-based creative teaching as changing web-based instruction to cultivate students' creative thinking and problem solving abilities. Accordingly, web-based creative thinking teaching utilizes creative thinking strategies matching with curricula for students applying the imagination so as to cultivate students' fluent, flexible, unique, and elaborative thinking abilities. A teacher, on the other hand, could perceive happy fulfilment and achievement in the lively web-based instruction (Jong et al., 2013). Bill & Francesco (2011) proposed three web-based thinking teaching principles of teaching for thinking, teaching of thinking, and teaching about thinking. Teaching for thinking intended to create school and classroom environments to facilitate thinking development; teaching of thinking aimed to teach students thinking skills and strategies; and, teaching about thinking would help students perceive individual and others' thinking processes and apply such cognition processes to daily life and problem-solving situations. Referring to Hasan &Abuelrub (2011), web-based creative thinking teaching is divided into three dimensions, and student behaviors from the interaction between teaching contents and teaching strategies are the expected creative teaching goal. 1. Cognition: It is to understand students' thinking fluency, flexibility, uniqueness, and elaboration. 2. Affection: It concerns students' curiosity, challenge, risk, and imagination. 3. Skill: It stresses on expertly applying creative thinking strategies to create novel and proper works.

## Creativity

Creativity is the interaction between personal mental operation and the factors of motivation, personality traits, knowledge, and social and cultural environments to form unique and useful concepts for solving problems (Chang, 2011). Creativity is a process of solving problems with creative thinking (Hilarie et al., 2012). For this reason, creativity is a problem-solving ability. Tsai et al. (2010) regarded creative thinking as a sequential process, including the awareness of problem deficits, knowledge gap, and element loss, to further discover difficulties, seek for answers, propose hypotheses, verify and re-verify hypotheses, and eventually generate

results. Cheng et al. (2013) indicated that creation was to apply cognition, imagination, and assessment to find out facts, problems, ideas, and acceptable solutions. Udo et al. (2011) referred creativity to students applying flexibility, uniqueness, and sensitivity to change common thinking methods into unusual and output thinking ones. Young (2011) considered that creative thinking started from the awareness of problems, followed by mental exploration and project proposal, to finally solve and verify problems. In the thinking process, a person should remain the spirit to look for changes, risk, and explore as well as present sensitive, fluent, flexible, unique, and elaborative characters. Sae-Khow (2014) pointed out creativity as the ability of a creator integrating associable elements to new relationship for specific needs or useful purposes. Deng & Tavares (2013) argued that creativity was not simply the personality tendency or ordinary ability, but the combination of personality traits, cognitive ability, and social environment. In this case, work motivation, skills in special field, and creativity related skills should be integrated for effective problem solving. Referring to Sung & Hwang (2013), four indicators to evaluate learners' individual creativity are used in this study. 1. Fluency: The ability of a participant generating concepts and ideas. It is usually the presentation of sensitive responses and fluent thoughts (Wang, 2007). 2. Flexibility: A method of a participant changing the thinking and the degree to respond to changes. 3. Uniqueness: The ability of a participant coming out of different or rare ideas. 4. Elaboration: The ability of a participant adding details or refinement beyond basic responses.

## Learning outcome

Learning outcome is an indicator to measure a student's learning result as well as the major item in the teaching quality evaluation. The performance evaluation could stimulate and guide students' learning, and the evaluation result could have students and the teacher understand the learning and teaching results for explaining or improving teaching effectiveness (Cheng & Tsai, 2011). For measuring learning outcome, past research used to consider that trainees could best realize the effectiveness on learning outcome that it was better to measure learning outcome with self-evaluation (Ernest et al., 2013; Terzis& Economides, 2011; Sams& Bergmann, 2013; Wang & Chiu, 2011). Referring to Wang & Chiu (2011), self-evaluation is applied to measure students' learning outcome.

## Research hypothesis

Past research proved that creativity could be acquired through learning (Bill & Francesco, 2011; Michele, 2011). Creative thinking teaching mainly focuses on developing students' creativity. Creativity, being the richest potential of human resources, could be trained and learned and could be promoted through some creative thinking teaching strategies and skills. A lot of schools present obvious progress on creative thinking teaching and lots of curricula for the application; students should have the opportunity to accept creative thinking teaching, while teachers could benefit from creative thinking teaching (Tsai et al., 2010). Kim et al. (2012) regarded creative thinking teaching as a kind of attitudes and habits; at least, it was a kind of skills to train creativity. Apparently, creativity could be cultivated through creative thinking teaching (Cheung et al., 2011). Furthermore, the effectiveness of web-based instruction was proven to promote students' learning interests and creativity (e.g., Kuo, Hwang, & Lee, 2012; Zhang, &Nunamaker, 2003). It is therefore induced that

*H1: Web-based creative thinking teaching would positively affect creativity.*

Liu et al. (2011) indicated that students would encounter problems and generate questions, some of which could be solved with known knowledge and experiences, while others required creativity for the solution; therefore, learning process was also a problem-solving process. Problems required concept reconstruction or novel and unique solutions were regarded as creative problems. Cognitive psychology study considered creativity as a problem-solving element that creation process was the problem-solving process. In this case, learning, problem-solving ability, and creativity were closely related. Sae-Khow (2014) discovered that creative thinking teaching could promote students' creativity, problem-solving ability, and learning outcome. Sung & Hwang (2013) found out that teaching methods broke the boundary between subjects so that students applied knowledge and developed creativity in unlimited learning situations to facilitate the creative thinking and active learning attitudes and found out and solved problems in the process of team discussion and practical operation to enhance the problem-solving ability and promote the learning outcome (Harasim, 2012). The following hypothesis is therefore established in this study.

*H2: Creativity would positively affect learning outcome.*

Seo& Woo (2010) discussed the effect of online curricula on learning and discovered that students with web-based creative thinking teaching presented higher learning outcome. Cheng & Tsai (2011) did not find any differences in the learning outcome, with distance, audio & video, and conventional education. Based on the curricula with web-based creative thinking teaching to discuss the effect of team learning on learning outcome, it was discovered that team learning appeared higher learning outcome than individual learning; besides, team learning showed remarkable promotion of low-achievement students' learning outcome. Pa & Huang (2011) studied teaching with lectures & discussions and web-based creative thinking teaching and found out the higher learning outcome of the online learning team. Aiming at the effects of training methods, computer self-efficacy, and learning styles on learning outcome, Huang et al. (2012) observed the higher learning outcome of leaners with web-based creative thinking teaching. Ernest et al. (2013) also pointed out the higher learning outcome with web-based creative thinking teaching. It is therefore induced in this study that

*H3: Web-based creative thinking teaching would positively affect learning outcome.*

## RESEARCH METHODOLOGY

## Operational definition and measurement of variable

## Web-based creative thinking teaching

Referring to Hasan &Abuelrub (2011), web-based creative thinking teaching is divided into cognition, affection, and Skill. With Likert's 7-point scale, number 1 stands for extremely disagree, and number 7 represents extremely agree. The analysis results reveal that the overall reliability appears 0.89 on cognition, 0.81 on affection, and 0.85 on skill.

## Creativity

According to past research, creativity is classified into fluency, flexibility, uniqueness, and elaboration (Basadur, Runco, & Vega, 2000; Brinkman, 2010; Feldman, 2003). Referring to Sung & Hwang (2013), the scale is scored with Likert's 7-point scale, in which 1 stands for extremely disagree and 7 represents extremely agree. The reliability of the dimensions achieves the significance, and the overall reliability shows 0.84 on fluency, 0.87 on flexibility, 0.82 on uniqueness, and 0.86 on elaboration.

## Learning outcome

Referring to Wang & Chiu (2011), learning outcome is measured by students' self-evaluation; the overall reliability shows 0.93.

## Research subject and analysis method

Quasi-experiment in design of experiment is applied to test the hypotheses. Total 186 university and college students in Taiwan are divided into two groups in this study. The experimental group (93 students) receives web-based creative thinking teaching, and the control group (93 students) accepts conventional teaching. The designed teaching program is practiced in the curriculum for four months. The collected questionnaires are coded and verified the relationship among web-based creative thinking teaching, creativity, and learning outcome with Regression Analysis.

## ANALYSIS RESULT

## Regression Analysis Between Web-Based Creative Thinking Teaching andCreativity

This study applies 4 regressions to verify the effect of web-based creative thinking teaching on creativity. The first regression tests the effect of web-based creative thinking teaching on fluency, where cognition, affection, and skill present positive effects on fluency ($\beta=1.755$, p$=0.026$; $\beta=1.633$, p$=0.031$; $\beta=2.015$, p$=0.006$). The second regression tests the effect of web-based creative thinking teaching and flexibility, where cognition, affection, and skill show positive effects on flexibility ($\beta=2.117$, p$=0.000$; $\beta=1.983$, p$=0.012$; $\beta=1.849$, p$=0.019$). The third regression tests the effect of web-based creative thinking teaching on uniqueness, where cognition, affection, and skill reveal positive effects on fluency ($\beta=2.237$, p$=0.000$; $\beta=2.185$, p$=0.000$; $\beta=2.093$, p$=0.000$). The fourth regression tests the effect of web-based creative thinking teaching on elaboration, where cognition, affection, and skill reveal positive effects on elaboration ($\beta=2.425$, p$=0.000$; $\beta=2.377$, p$=0.000$; $\beta=2.174$, p$=0.000$). Consequently, web-based creative thinking teaching presents significantly positive effects on creativity that H1 is supported.

**Table 1.**Regression Analysis between web-based creative thinking teaching and Creativity

| Dependent variable / Independent variable | Creativity | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Fluency | | Flexibility | | Uniqueness | | Elaboration | |
| | β | P | β | P | β | P | β | P |
| Cognition | 1.755* | 0.026 | 2.117** | 0.000 | 2.237** | 0.000 | 2.425** | 0.000 |
| Affection | 1.633* | 0.031 | 1.983* | 0.012 | 2.185** | 0.000 | 2.377** | 0.000 |
| Skill | 2.015** | 0.006 | 1.849* | 0.019 | 2.093** | 0.000 | 2.174** | 0.000 |
| F | 13.267 | | 18.433 | | 21.834 | | 26.537 | |
| R$^2$ | 0.216 | | 0.233 | | 0.271 | | 0.295 | |
| Adjusted R$^2$ | 0.192 | | 0.212 | | 0.246 | | 0.274 | |

*p$<0.05$ **p$<0.01$
*Data source: this study*

### Regression Analysis between Creativity and Learning Outcome

This study tests H2 with regressions. From the regression, fluency, flexibility, uniqueness, and elaboration of creativity show positive effects on learning outcome ($\beta=1.738$, $p=0.024$; $\beta=1.924$, $p=0.015$; $\beta=2.169$, $p=0.000$; $\beta=2.246$, $p=0.000$). As a result, creativity would positively affect learning outcome that H2 is supported.

**Table 2.** Regression Analysis between creativity and learning outcome

| Dependent variable ⟶ | Learning outcome | |
|---|---|---|
| Independent variable ↓ | β | P |
| Fluency | 1.738* | 0.024 |
| Flexibility | 1.924* | 0.015 |
| Uniqueness | 2.169** | 0.000 |
| Elaboration | 2.246** | 0.000 |
| F | 16.423 | |
| $R^2$ | 0.194 | |
| Adjusted $R^2$ | 0.159 | |

*$p<0.05$  **$p<0.01$*
*Data source: this study*

### Regression Analysis between Web-Based Creative Thinking Teaching and Learning Outcome

From the regression, cognition, affection, and skill appear positive effects on learning outcome ($\beta=2.531$, $p=0.000$; $\beta=2.392$, $p=0.000$; $\beta=2.188$, $p=0.000$). H3, web-based creative thinking teaching shows positive effects on learning outcome, is therefore supported.

**Table 3.** Regression Analysis between web-based creative thinking teaching and learning outcome

| Dependent variable ⟶ | Learning outcome | |
|---|---|---|
| Independent variable ↓ | β | P |
| Cognition | 2.531** | 0.000 |
| Affection | 2.392** | 0.000 |
| Skill | 2.188** | 0.000 |
| F | 22.457 | |
| $R^2$ | 0.263 | |
| Adjusted $R^2$ | 0.231 | |

*$p<0.05$  **$p<0.01$*
*Data source: this study*

### CONCLUSION

The research findings show that web-based creative thinking teaching could enhance students' creativity in solving problems. The currently popular web-based creative thinking teaching therefore could activate teaching methods, make flexible teaching time, enhance peer interaction, positively criticize and clarify problem-solving methods, advantageously propose creative problem solutions, and achieve the teaching goal of curricula. The research results show that students in the experimental group who receive creative thinking teaching reveal higher performance on the creativity of fluency, flexibility, uniqueness, and elaboration than those in the control group accepting conventional teaching. It proves that web-based creative thinking teaching could stimulate students' creation potential and

promote the creative thinking performance. From the viewpoint of creative thinking teaching, it is important to present the creation behaviors in the process, rather than simply stressing on the creation results. Creative environments not only could benefit the generation of motivation but could also enhance the continuity of creation behaviors to benefit students learning creative thinking ability and to further promote the learning outcome.

## Suggestion

According to the research results, the following suggestions are proposed in this study.

I.    Curriculum design: Creative thinking teaching indeed could stimulate students' creative thinking ability to think of many innovative ideas. Nonetheless, web-based creative thinking teaching presents practical characters that students have to closely combine theories and practice in the operation. Besides, a lot of operation problems could be encountered that, in addition to teaching creative thinking strategies, creative problem-solving methods could be offered in the curriculum design for students practicing creative thinking strategies in the real situations in life.

II.    Curriculum practice: It is suggested to break conventional lecturing and apply grouping model so that team members with different backgrounds could break original learning climate, create innovative climate, and induce new flare from heterogeneous cooperation, allowing students actively participating in the curricula by matching active and interesting activities and encouraging students stimulating creative thinking abilities by mutual discussion and feedback.

III.    Curriculum time distribution: It requires time to brew creative thinking. When processing the curriculum, students should be given more time for thinking or brainstorming so that the students in each group could thoroughly discuss and stimulate new ideas. Moreover, a series of web-based creative thinking teaching curricula is better arranged with plans and permanent planning in order to help students internalize creative thinking strategies to become personal cognition structure, practice the spirit of creativity in daily life, and expand personal creative ideas to groups to further construct the creative climate and generate the supportive environment.

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