

PATHWAY TO CREATIVITY: MODERN CREATIVITY TRAINING IN TERTIARY EDUCATION

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Creativity is usually regarded as the core competence of the modern individuals, groups, enterprises, societies even countries. Educationalists have had numerous researches in this field. Mostly using the method literature review, this article compiles a outline of over 100 pieces of journal articles, trying to give an overview of some novel creativity education trials within 30 years. This article adopts 'dot & line' pattern, which means it will contain both the progress trace and several noteworthy case studies. After offering an insight into this field, this article also hammers out some re-organized suggestions for the education industry and further research.

Keywords: creativity, higher education, education promotion

1 Background information

The resource of the journal articles is *Elsevier*, and the period of the papers covers from 1990s to this year, 2022. The scientific study of creativity emerges since the mid-twentieth century (Torrano & Ibrayeva, 2020). Meanwhile, some creativity training went into the sight of horizon in the 1950s, such as some problem-solving-oriented approaches, like brainstorming program put forward by Osborn.(Maria M. Clapham, 2003).

During the following several decades, many creativity training practices were born, including Creative Problem-Solving (CPS) (Osborn & Parnes), Synectics (joining together unrelated elements)(Gordon & Prince), Lateral and Vertical Thinking(Edward de Bono), Hemisphericity (based on the hemisphere theory of brain science) (Ned Herrmann), Packaged Educational Programs (a set of programs, emphasizing divergent thinking) (Purdue), Psychogenics and Psychosynthesis (based on incubation theory and unconsciousness theory)(Wenger & As-sagioli) etc.

However, almost all of these creativity training is out of experiences, theory deduction or even habitual conception. Correspondingly, review of the creativity training was started in 1972 by Torrance, which is named Torrance Tests of Creative Thinking (TTCT). Later in 1980s, meta-analytic techniques were introduced. Such researches were conducted by Rose & Lin (1984) and Cohen (1984). In this way researchers have a criteria to determine whether the creativity training is effective or not.

Generally investigating these journal articles we use as sample, it can be witnessed that though the research on

creativity training is quite early, the mainstream field of the education did not set their eyes onto creativity education until the start of the twenty-first century. But the sum of articles had a remarkable surging in around 2014&2015 and remain being in a high-level up to now.

2 Clarification & Definition

Due to the fact that the creativity is a complicated and composite conception with ambiguous border, in the present paper, we will review the former assessments and classifications of creativity, and integrate them to form a comprehensive definition of creativity.

2.1 Former definitions for creativity

Basically, creativity should be acknowledged as a feature of human thought, rather than kind of psychological disorder. (Emilie Glazer, 2019) Besides, some stereotype that the creativity is directly related to intelligence (eg. threshold theory) should be re-considered (Franzis Preckel et al., 2006)

Based on the past research, the definition of creativity can be categorized into two sorts, element analysis and dimension analysis. In addition, the present paper will offer another two side aspects, non-academic factors and cross-cultural vision.

2.1.1 Element analysis

In this sort of models, the researchers try to decompose the notion 'creativity' into several foundational qualities. In this view, creativity is a set of intellectual abilities. One example (Ott & Pozzi, 2010) is displayed below. Ott and Pozzi categorize the indicators into 3 sorts, cognitive category, meta-cognitive category and affective category.

- Cognitive category (Bloom et al., 1956) refers to the traditionally believed intellectual capabilities. It is composed of producing (giving rise to new act or product), planning (figure out or design the solution of the problem, defining methods) and generating (making mental representation of the problem and making comparison).
- Affective category (Kearney, 1994) has to do with the emotional status and attitudes towards the proposed activity, namely, what they think about what they do. Affective category includes responding (positive/negative react to the stimuli) and receiving (involvement and immersion in learning activities).
- Meta-cognitive category (Flavell, 1976) is about taking the overall process (their own cognitive process) under control. Meta-cognitive consists of monitoring (ability of recalling and evaluating own cognitive process, evidencing strengths and weakness), regulating (reviewing, controlling and tuning) and evaluating (comprehensive judgement of obtained result).

2.1.2 Dimension analysis

On this viewpoint, the theorists tend to demonstrate creativity as a single feature with several 'parameters' (like vectors in the coordinate system). (Emilie Glazer, 2019) This aspect mainly emphasize the function domain and situation of the creativity.

Glazer sets two axis for the coordinate system, with eminent creativity & everyday creativity as well as art domain creativity & science domain creativity, respectively. These two dimensions severally depict the rational-emotional and large/small-scale attribute of the circumstance where the creativity make a difference.

2.1.3 Non-academic factors

Admittedly when assessing the creativity level of a certain object or person, we could hardly be definitely objective. (Elsbach Kramer, 2003) Individuals who are involved in product creation tend to overestimate the creativity of their work, while individuals not involved lack understanding of the creative process, which leads to irresponsible judgement without scrutiny. When judging the creativity, a series person-related and situation-related factors, such as the involvement in the product, whether it's a

mutual judgement and even the order of the procedure etc. have an impact on the accuracy. But well-structured judging system helps to moderate the effect. (Damian P. Birney et al., 2016)

2.1.4 Cross-cultural perspective

Although we have a system to evaluate creativity and some method to ensure the accuracy of the assessment to the maximum extent, we may still be in face of barrier in the cross-cultural perspective. Actually, when translated, the terms used to describe the element/dimension of the creativity may not have directly corresponding words (Fryer et al., 2011), which results in misleading information. In this context, we could identify that the essence of the problem is that all the criteria are only literal descriptions, instead of concrete indexes, so that we could not convey the standard precisely all the time.

2.2 A model for creativity

According to the models constructed by the former researchers, we will establish a comprehensive model for creativity. Integrating the two sorts, these criteria adopt self-object and self-self as two dimension, and adopt pre, ongoing, post as three element, so that there are 6 indexes crosswise.

- pre+self-object: Pre-arrangement, prediction
- pre+self-self: Motivation
- ongoing+self-object: Observation, divergent thinking
- ongoing+self-self: Ability of proving a certain method
- post+self-object: Abstraction, encapsulation
- post+self-self: Form experience, Re-utilization

3 Dot review of modern creativity education researches

From the sample, we select 6 case studies which among the highest relativity items with the key word 'creativity' and 'higher education' in the searching engine of *Elsevier*. Meanwhile, they reflect the applied technology development along with the time.

3.1 Micromouse competition(2010)

The micromouse competition refers to maze exploring design competition, the competition was aimed at college student.(Hayama Matsumoto, 2010) Nowadays, this kind of relatively less technique-required competition have submerged to the middle school students crowd. However, a large quantity of competitions with this as a blueprint offer more alternatives for higher education students.

3.2 Creativity research in Czech Republic(2013)

Current stiff study structures prevent from creativity at universities.(Likeschová et al., 2013) The researchers identify that the job-oriented education strategy (technical/technically-economical education) spoils the emergence of creative minds. Against these phenomenon Likeschová et al. put forward the plan to reset the school system. Specifically, they propose a separation of theoretical universities and schools only focusing on applied research.(the conference 'Forum for creative Europe', 2009)

3.3 Influence of ICT(Information and Communication Technology) on Creativity Education(2015)

Through case studies, the researchers identify the three aspects of the positive effects.(A. Sokół et al., 2015)

- E-information accuracy and inquisitiveness, creative ability, professional and general knowledge and self-reliance
- E-education conscientiousness / reliability/ consistency, involvement, creative ability, professional and general knowledge and self-discipline.
- E-contact professional ethics, communicativeness, information management, creative ability, sharing knowledge and experience, proper documentation handling and self-motivation

3.4 SCAMPER teaching & substantial value of data mining in creativity education(2020)

The study(Yu-Cheng Chien, 2020) is based on analysis of the records of student discussion.

SCAMPER teaching strategies were introduced during the preparation of the study, including seven aspects of thinking, namely substitute, combine, adapt, modify, put to another use, eliminate, and reverse (Suh, 2019; Wu Wu, 2020). These steps aim to encourage students to think outside the box and develop new ideas based on their existing knowledge.

The approaches was incorporated to the curriculum through preparation, implementation, presentation, evaluation, and revision. In addition, learners were permitted to divide up the tasks assigned to them to accomplish thematic objectives, and they could cultivate and adopt multiple perspectives to improve their problem-solving capacities through discussions and interactions on the platform.

The innovation of curriculum offers a flexible template of the course design for universities. Meanwhile, the processing of the original data enlighten a new pathway to explore pedagogical disciplines by data mining.

3.5 Mobile tech supporting creativity reinforcement(2020)

In this study(Jahnke Liebscher, 2020), the researchers identify three domains where mobile technology assists in the reinforcement of creativity through several case studies.

- Mobile technology to enhance creativity through communication:
 1. The instructor supported reflective learning: Within a large-scale lecture, the instructor provided questions by using a certain app (Peer Discussion) and distributed the questions to the students. Students prepared individual answers. Then, the instructor presented the student results on the screen and students were given the opportunity to discuss the results to come to a joint understanding.
 2. The instructor enhanced autonomous learning: In the curriculum the students are allowed to discuss and make decisions about exam tasks by using mobile technology.
- mobile technology to enhance creativity by linking non-traditional, non-campus places:
 1. The instructor supported reflective learning: The students used mobile devices to document the stages of development and, based on the theoretical content of the lecture, reflected to their experiments.
 2. The instructor supported autonomous learning. The instructor allows students to control their own learning processes and autonomous learning. Students have rights to choose which times they wanted

for their observation at a non-university learning location.

3. The instructor supported curiosity and learning by asking critical questions: The students demonstrated the theoretical development in practice on real plants and their documentation was coupled back into the lecture. The instructor also promoted the practical relevance with a real-world problem.

- Mobile technology to enhance creativity through processes of producing an artifact:

1. The instructors supported reflective learning: The instructors promoted this by offering the students roles or responsibilities for development within their groups, but the students assigned themselves to these roles according to interest. The students received support from the instructors and peers in formative assessment during the project. The instructors encouraged students to reflect on their methods and their learning processes by writing in a learning journal.

2. The instructors supported autonomous learning: The instructors gave students the freedom to choose their work content and the topic for the app. The students selected their roles and independently started to work out the concepts by planning and implementing steps.

3. The instructors supported curiosity and learning by asking critical questions: The assignment gave students the freedom to include ideas and topics from their everyday lives, and to solve a real-world problem by designing and investigating apps, thereby creating a practical relevance that went beyond the subjects of the course.

4. The instructors supported learning by producing: Students developed a novel solution by creating a certain product in the course product.

5. The instructors supported novel student ideas: In the course of the case study, students developed pedagogical usable prototypes for learning apps for mobile learning. The students had the option to be creative by developing completely new ideas for the learning projects, instead of finishing the products strictly within the offered frame.

3.6 Interdisciplinary, project-oriented problem-based learning(2022)

In the recent studies ,the education practitioners turn their attention to the interdisciplinary education mode. This research affirm the effectiveness of interdisciplinary, project-oriented problem-based learning (Te-Sheng Chang et al., 2022) In the study, the researchers

invite four professors from four distinct disciplines (future studies, architecture, engineering, and education) to design a Project-Oriented, Problem-Based Learning (POPBL) curriculum, including participatory design, future thinking, and visual communication, and implement it. The course targets at undergraduates.

According to the quasi-experiment report, the fluency, flexibility, originality, and usefulness of the experimental group have a significant leap, which verifies the function of POPBL curriculum.

In addition the research team proposed another notion '*empathetic-future thinking*', to describe the participatory pedagogy integrated in the curriculum design. The projects in the curriculum encourage participators develop a sense of empathy for cross-domain cognition and the end-users of the design, centred on community-based feedback and interdisciplinary communication and teamwork, which enhanced the originality and usefulness.

3.7 Other studies in a certain domain

Actually, along with the exploration in the general notion of creativity training or education, researches on methods developed for a specific field are conducted these years. A few samples are listed below.

- Religion:
Creativity in the teaching of shariah studies in institutions of higher education (Irwan Mohd Subri et al., 2012)
- Nursing:
A systematic review of creative thinking/creativity in nursing education (Zenobia C.Y. Chan, 2013)
- Business:
Seeing around corners: How creativity skills in entrepreneurship education influence innovation in business (Lisa K. Gundry et al., 2014)
- Hospitality: The creativity level of Taiwan hospitality undergraduate students (Shu-Ying Lin et al., 2014)
- IT:
Students' perceptions of creativity in learning Information Technology (IT) in project groups (Chunfang Zhou et al., 2014)
- Architecture:
Creativity and knowledge in architectural education (Hacer MUTLU DANACI, 2015)

Examining the plausibility of fostering creativity through puzzles in architectural education: An exploratory sequential study (Ramaraj & Nagammal, 2017)

- Environment:

Developing individual creativity for environmental sustainability: Using an everyday theme in higher education (Vivian M.Y. Cheng, 2019)

- Management:

Realising creativity in management education: Putting student energy into action (Roz Sunleya et al., 2019)

- Art:

Creativity in Higher Education Contemporary Dance An Interpretative Phenomenological Analysis (Clements & Redding, 2020)

4 Line review:discussion of creativity indicators and comprehensive suggestions

- From the view of educator:

The creativity, self-efficacy, energy, risk-propensity, and leadership skills of the teachers themselves determines whether they can provide high-quality teaching in creativity.(Dan Davies et al., 2014; Huang Krasikova et al., 2016; Jan Watson, 2018)) However, nowadays, most educators are indecisive about their ability(Hosgörür Bilasa, 2009) and lack of training(Jan Watson, 2018). For high-quality teaching, teachers need to have a positive attitude towards creativity and feel confident about their own skills base. (Dan Davies et al., 2014) For this to happen, in-service training seminar is highly required(Hosgörür Bilasa, 2009). There have been models developed to improve preservice teachers' professional development with respect to creativity instruction(Yu-chu Yeh et al., 2011). All the teacher should also be allowed to involve in gifted education which promote their own creativity.(Chan Yuen, 2014)

The enthusiasm of the teachers, which plays a significant role, even overweighs the metacognition of them(Huang et al., 2021). Therefore, every factor that may potentially spoil the enthusiasm should be avoided. Status differentiation and teacher's participation in school decision should be reduced(Huang et al., 2021) Instead, when making a decision, it is better to involve a variety of teachers.

- From the view of the educated:

What we should consider first is to break the stereotype on creativity. In divergent thinking training program, students with either a high or low level of creative potential equally benefited from the training.(Meng Sun et al., 2020) The genius-only theory do not make sense. Moreover, freedom of thought do not always mean creativity. On the contrary, educators could implement constraint-based strategies to develop student creativity.(Tromp Baer, 2022) Besides, we should embrace traditionally so-called harmful things. Properly extensive use of Facebook in a course is proved effective.(Stolaki Economides, 2018)

For the educated themselves, developing the habit of action plan(Ayvaz Durmus, 2021) and improving self-efficacy(Zahir Vally et al, 2019) are expected.

Some training methods are proved to be practical. For instance, computer-based simulations which presents contextually meaningful problem situations that require learners to analyze and prepare solution proposal(s) are developed. Following the learner input, the simulation assesses the proposal and offers back to the learners the consequences of their decisions while also iteratively updating the situational conditions. This kind of complex-dynamic simulations could improve and elaborate learner cognitive abilities.((Tennyson Breuer, 2002)) Other methods like transformational teaching(Daniela Pachler et al., 2019)and Role Play Training in Creativity (RPTC)(Karwowski Soszynski, 2008) are also proved effective.

When it comes to the concrete instruction in the college classes, teachers are suggested to highlight hands-on participations(Rasidah Mahdi et al., 2015), higher student involvement for decision-making and flexibility (Javier Pulgar, 2021) to form a beneficial positive learning environments(Chang-Yen Tsai et al., 2015). Guided problems solving outside the classroom environment could be the supplement.(Rasidah Mahdi et al., 2015) When arranging the content of the course, teaching domain knowledge and teaching domain general skills should not be opposed but work best when integrated together.(Meng Sun et al., 2020) Nevertheless, the universities are expected to maintain the emphasis on academic training. Science process skills had a simultaneous correlation to scientific creativity.(Zainuddin, 2020) The feedback system of the school should also be complete, for award-winning experiences will encourage students creativity.(Shu-Hsuan Chang et al., 2016)

Some interpersonal skills also have to with creati-

ity. New study indicates that reappraisal (a method for emotion regulation) assists creativity (Zhu et al., 2023). Another study indicates that the creativity of graduate students could be enhanced by their social capital sources (including peer, advisor, and expert). So that policymakers could establish a number of rules and mechanisms to ensure that graduate students can frequently and efficiently communicate with their supervisors (Jibao Gu et al., 2014). Those who behaved politely (polite disagreements, questions/statements). Teachers might encourage students to evaluate ideas carefully, speak politely, and avoid impulsive responses to rude behaviors. (Ming-ming Chiu et al., 2008). Besides, cross-organisational Communities of Practice (CoPs) could also stimulate creativity. (Aekaterini Mavri, 2021) (CoPs are social groups that share common interests and goals in a particular field, and interact to build relevant knowledge and expertise.)

It's identified that meta-cognitive awareness play a key part in the formation of creativity. (Kamila Urban et al., 2021)

External environment have to do with the undergraduates' creativity. In neuroscientific perspective, proper stress stimuli affects hormones and emotions, which enhances creativity. (Yu-chu Yeh et al., 2015). Even physical surroundings, like plants, green color pose an effect. (Daniela Pachler et al., 2016)

The more students involve in the system, the more improvement of learning, creativity, and innovation process grow fast. (E.M. Sutanto, 2017). So the policy makers should apply a participative leadership instead of autocratic leadership. They should allow the students to let their voice to be heard. Increasing freedom of speech in the universities will create positive climate.

5 Suggestion for further research

Generally speaking, the research in creativity education are atomic. Further researches could be conducted to systematize the research findings to form a topological structure. Besides, some teaching instructions or manuals based on the past researches are highly required. Only in that way can metaphysical pedagogical theories turn into pragmatic and practitioner-friendly outputs, which fits for the nature of education.

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