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WHY DOES HE GET AWARD? COMPARISON OF INNOVATIVE THINKING POINTS

Abstract:

Innovation is an important basis for successfully gaining global market shares in the era of technological changes. In order to maintain national competitiveness, the government attaches great importance to innovative thinking ability. To this end, throughout various stages of education in Taiwan, creativity competitions are held. Among them, at universities and colleges, annual innovation and entrepreneurship competitions are held; at vocational high schools, national creativity project work competitions are held. In this study, award-winning students from the two competitions were selected. The creative concept design capability scale was adopted to compare the award winners and non-winners in terms of differences in innovative thinking points. The creative concept design capability scale was used to assess the gap among students who received training, college project instructors, and student innovative thinking points. Findings show that the overall innovative thinking points are mostly concentrated in the appearance. University/college of technology or vocational high school competition award winners alike have a significantly higher total score compared to the total innovative thinking points score of regular university/college of technological teachers and students. However, as to the innovative thinking points for different categories, university and college award winners of innovation entrepreneurship competitions tend to put the chemical change of innovative thinking points to better uses; vocational high school award winners of creativity project work competitions tend to put the external size and external texture layout of innovative thinking points to better uses. The university and college students on the project team are better able to use the physical changes, structural complexity, operability, shape changes, functional enhancement, and usage enhancement of the innovative thinking points. This study recommends that students select more related professional practical courses to “learn by doing”. Students are encouraged to participate in off-campus learning activities or creativity competitions so that they can broaden their horizons. As for teaching, teachers may lead students in site visits to learn about innovative products in the industry. The course design combines theory and practice, case discussions are examples of which.

Keywords:

Innovative thinking points, Competition award winner, Creativity

JEL Classification: I20, I23, I29

Introduction

MIT's Lester Thurow research shows that creativity is the fuel of the information age. It is time to look at the relationship of amenities, creativity, technology and e-commerce to the globally competitive region and its ability of attracting the best and the brightest (Mitsumoto, McNulty and Partners for Livable Communities, 2004). According to the definition of Robinson and Aronica (2015), imagination is the root of creativity that brings to mind things that aren't present to our senses. Creativity is putting your imagination to work that applied imagination. Innovation is putting new ideas into practice. However, creativity is not a linear process; before you get started you have to learn all the necessary skills. It is true that creative work in any field involves a growing mastery of skills and concepts. Obviously, countries can only achieve progress through innovative and creative ideas. In other words, innovation capacity is of great importance to countries, enterprises, and schools. After Barack Obama, the first African-American President of the United States, was elected President, education policy underwent reform through creativity, innovation, and entrepreneurship (Wu and Fan, 2011). Enterprises have high demands for talents with innovative thinking, while innovation education has gradually undergone development in schools. Therefore, this study aimed to explore the difference between creativity competition award winners and teachers and students from regular universities and colleges in terms of their innovative thinking points. Based on the research results, recommendations for future teaching and learning improvement practices were proposed. This study is intended to develop students' creativity to cultivate their innovation capability in thee workplace.

Literature Review

Creativity

According to the classification of Bröckling (2006), creativity can be divided into six associative fields. First, creativity is associated with artistic action, with the moment of expressivity occupying the foreground. Second, creativity is conceived in terms of production. Third, the concept of creativity as problem-solving action, with stress being placed on invention and innovation. Fourth, creativity here means liberating action, a radical new invention of social structure: the human being confronts the world as a border-transgressor, a 'creative destroyer'. Fifth, creativity is associated with life, include birth, generation and biological evolution. Sixth, creativity is that of play, identifying creative with purposeless activity. In the flurry of metaphors, each person discovers his or her own.

Chen and Chen (2014) integrated multiple researches to define creativity in three aspects: originality, appropriateness, and diversity.

1. *Originality* refers to the ability to innovate and turning nothing into something, problem-thinking at different angles. Works proposed are developed by breaking through original thoughts or opinions. The concepts include originality, rarity, degree of novelty, and so on.
2. *Appropriateness* refers to the appropriateness of a product, the degree of functional value, the style implication, the structural integrity, and effective problem solving. The concepts include: practicality, exquisiteness, problem-solving ability, degree of conceptualization completeness.
3. *Diversity* refers to the quantity of works and multiple types of integration in a single mission. It is a person's ability to continue to generate various uninterrupted thoughts or answers. The concepts include: fluency, flexibility, degree of diversification, divergent thinking ability, etc.

Although creativity may be inborn, it is also the process of the teacher's use of a novice teaching method, innovative strategy, and innovation. Teaching flexibility leads to learning motivation and helps students enhance their creativity or innovation ability. In addition, creativity can promote students' critical thinking; it can also improve the overall goal of life.

Creativity Competitions

Ito, Ichikawa, Hanumara, and Slocum(2014) pointed out in their study that the students' perspective on taking classes does not always mean that a class is attractive, because often it is mandatory. Being exhibited in a competition, and giving students ownership and responsibility for a goal will be an effective way to make a class attractive. Through students' participation in competitions, students can "learn by doing", thereby enhancing their knowledge and skills. Finally, creative products are developed through integration (Wang, Chang and Huang, 2011). Through the conduction of creativity competitions, the learning effectiveness of teachers and students' project work can be enhanced.

In addition, the goal of creativity related competitions is to enhance students' professional and innovation ability, as well as eliciting their creative potential. It is expected that through competitions, more creativity can be elicited. The creativity competitions held by universities and colleges in the recent three years were collected in this study, including five competitions: ASME Innovation Showcase, Innovation Competition (Microsoft Imagine Cup), Intelligent Ironman Creativity Competition, Creative Project Competition of Vocational High School, Innovative and Entrepreneurial Competition on University/College of Technology (As shown in Table 1 Contents of creative competitions in recent three years).

Table 1: Contents of creative competitions in recent three years

Competition name	Organizer	Activity objective and content
Intelligent Ironman Creativity Competition	Youth Development Administration(2015)	Competitions equally emphasize culture and technology, creativity implementation, and multi-disciplinary knowledge integration. The activity includes games that allow students to learn while playing. Through teamwork, creativity is implemented, while multi-disciplinary knowledge is integrated. The activities serve as templates for teachers to incorporate creativity into their teaching, thereby strengthening curriculum implementation.
Creative Project Competition of Vocational High School	K-12 Education Administration (2013)	The activity is intended to encourage vocational high school students to actively take part in project work. From project work, innovative thinking, implementation ability, multi-disciplinary knowledge integration, and interpersonal communication skills are cultivated. Shortening the education-jobs gap will promote grassroots personnel in the industry.
Innovative and Entrepreneurial Competition on University/College of Technology	Technological and Vocational Education (Industry-Academia Collaboration Center of NTUT, 2015)	The activity is intended to help students realize their dreams. Competitions provide entrepreneurship resources, assist innovative companies through their operations, and encourage student groups intending to start up their won business to participate. The purpose of activities is to cultivate young entrepreneurship

Competition name	Organizer	Activity objective and content
		teams to face fierce market competition and develop the innovative mindset. Students will be willing to create new social values, thereby boosting economic growth and enhance national competitiveness.

Through implementation competitions, students can learn how to solve real life problems. By integrating knowledge from different fields, creative thinking and problem inquiry ability can be developed. Competitions enable students to engage in mutual learning with others through observation. Joining a competition for the purpose of completing the implementations project for graduation, the learning effectiveness will be even better.

Research Design and Implementation

Assessment of Creative Concept Design Capability

In this study, the “creative concept design capability scale” prepared by Hsiao, Chang, Huang (200) was revised. The original scale was used to test the rater’s reliability, with the overall innovative thinking points of .97 and a fluency of .987. The correlation coefficient of fluency and overall creativity reached the significant standard. Finally, the scale established the expert validity through focus group interviews.

The scale contents cover 12 items, including paper clips, pens, springs, easy-open cans, bottles, travel cards, motors, wires, straws, balloons, leaves, and ping-pong balls. Each item may vary in size, material, shape, and quantity; it may also be structurally changed to develop new features and serve other purposes. In this study, five sheets of blank paper were provided for sketching works.

As for rater reliability, the Pearson correlation coefficient was .886 (total score), and the Kendall’s correlation coefficient was .647 (rank), both possessing significance. Therefore, the ratings of the experts for the overall creativity (total score) showed consistency. The rating items are as follows:

1. Innovative thinking points: The works with innovative thinking points were checked.
   (1) Material: improvement, physical change, chemical change.

(2) Mechanism: structural complexity, operability.

(3) Appearance: size, shape variability, production quantity, texture layout.

(4) Function: added product functions, added usage.

2. Fluency: The scoring is based on the quantity of product design ideas and low work relatedness. Each work piece is awarded one point, and so on and so forth. The maximum score is five points.

3. Overall creativity (total score): The total score range is 0-100. Innovative thinking points and the uniqueness of works are taken into consideration.

Research Participants

In this study the assessment of the creative concept design capability of winners from larger-scale creativity competitions in Taiwan were selected, including 11 groups from "2014 Innovative and Entrepreneurial Competition on University/College of Technology " and 14 groups from "2014 Creative Project Competition of Vocational High School". Additionally, 26 university/college of technology project work course instructors and students were randomly sampled. The works of former groups were cross-rated by instructors from other groups; the works of latter groups were cross-rated by eight experts engaged in creativity research.

Results

Overall Performance in Innovative Thinking Points

In this study, the four dimensions of material, mechanism, appearance, and function underwent non-parameter χ^2 . The frequency distribution is as shown in Table 2. The overall innovative thinking points are mostly concentrated in the appearance dimension (29.8%). Among the innovative thinking points dimensions, material improvement (62.64%), structural complexity (52.73%), external shape variability (31.11%), added product functions (53.85%) have higher ratios. The overall innovative thinking points (χ^2=80.366, p<.001) reach significant difference. The respective innovative thinking points dimensions that reach significance include: material (χ^2=46.308, p<.001) and appearance (χ^2=8.615, p<.05).

Table 2: frequency distribution on innovative thinking points of creative competition award winners and university/college of technology project teachers and students

Points	N	Percentage	Value	Overall
Material	**91**	**20.09%**	46.308***	80.366***
improvement	57	62.64%		
physical change	30	32.97%		
chemical change	4	4.40%		
Mechanism	**110**	**24.28%**	0.327	
structural complexity	58	52.73%		
operability	52	47.27%		
Appearance	**135**	**29.80%**	8.615*	
size	41	30.37%		
shape variability	42	31.11%		
production quantity	21	15.56%		
texture layout	31	22.96%		
Function	**117**	**25.83%**	0.692	
added product functions	63	53.85%		
added usage	54	46.15%		
Total	**453**	**100.00%**		

*p<.05, ***p<.001

Comparison of Innovative Thinking Points

Total Score of Innovative Thinking Points

In this study, the Kruskal-Wallis test was adopted. Using the total score for four groups, namely, the university/college of technology award winners, vocational high school award winners, university/college of technology project students, university/college of technology project instructors from different populations, the mean score was tested. The nonparametric statistical test analysis results (Table 3) show that the chi-square value reaches significant difference ($\chi^2(3)=49.982$, $p<.000$). Post Hoc multiple comparison uses Dunnett t test for explanation (Table 4). The comparison of the innovative thinking points total score results show that the university/college of technology and vocational high school award winners are significantly higher than the university/college of technology project students and instructors.

Table 3: Nonparametric statistical test analysis of the total score of innovative thinking points of different groups

Group	N	M	χ^2 Value	*p* value
(A) university/college of technology award winners	10	66.55	49.982*	.000
(B) vocational high school award winners	15	63.87		
(C) university/college of technology project students	26	26.15		
(D) university/college of technology project instructors	26	26.90		
Total	77	45.45		

*p<.05

Table 4: Dunnett t test analysis of the total score of innovative thinking points of different groups

Group	Comparison	M	SD	*p* value
(A)	(D)	66.569*	5.818	.000
(B)	(D)	64.436*	5.069	.000
(C)	(D)	3.038	4.336	.842

*p<.05

Comparison of Differences in Innovative Thinking Points

In this study, the different groups and the innovative thinking points underwent cross-analysis. Table 5 shows the cross-analysis of the innovative thinking points of different groups. The chi-square test results show that the different groups reach significant difference. The vocational high school award winners and the university/college of technology project instructors have particularly high scores in external size (χ^2=19.918, p<.001) and shape (χ^2=8.919, p<.05), while the vocational high school award winners have more outstanding scores in texture layout (χ^2=29.697, p<.001), and the university/college of technology product students and teachers have distinctively higher scores in product functions (χ^2=8.416, p<.05).

Table 5: Cross-analysis of the innovative thinking points of different groups

Points	(A)	(B)	(C)	(D)	χ^2 value	*p value*
Material						
improvement	8 14.04%	14 24.56%	18 31.58%	17 29.82%	4.414	.220
physical change	4 13.33%	5 16.67%	9 30.00%	12 40.00%	0.976	.807

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chemical change	2 50.00%	1 25.00%	0 0.00%	1 25.00%	6.037	.110
Mechanism						
structural complexity	9 15.52%	13 22.41%	15 25.86%	21 36.21%	6.961	.073
operability	6 11.54%	14 26.92%	14 26.92%	18 34.62%	7.068	.070
Appearance						
size	9 21.95%	13 31.71%	7 17.07%	12 29.27%	19.918*	.000
shape variability	8 19.05%	11 26.19%	9 21.43%	14 33.33%	8.919*	.030
production quantity	2 9.52%	5 23.81%	7 33.33%	7 33.33%	0.548	.908
texture layout	9 29.03%	12 38.71%	5 16.13%	5 16.13%	29.697*	.000
Function						
added product functions	10 15.87%	14 22.22%	17 26.98%	22 34.92%	8.416*	.038
added usage	8 14.81%	14 25.93%	14 25.93%	18 33.33%	7.621	.055

*$p<.05$

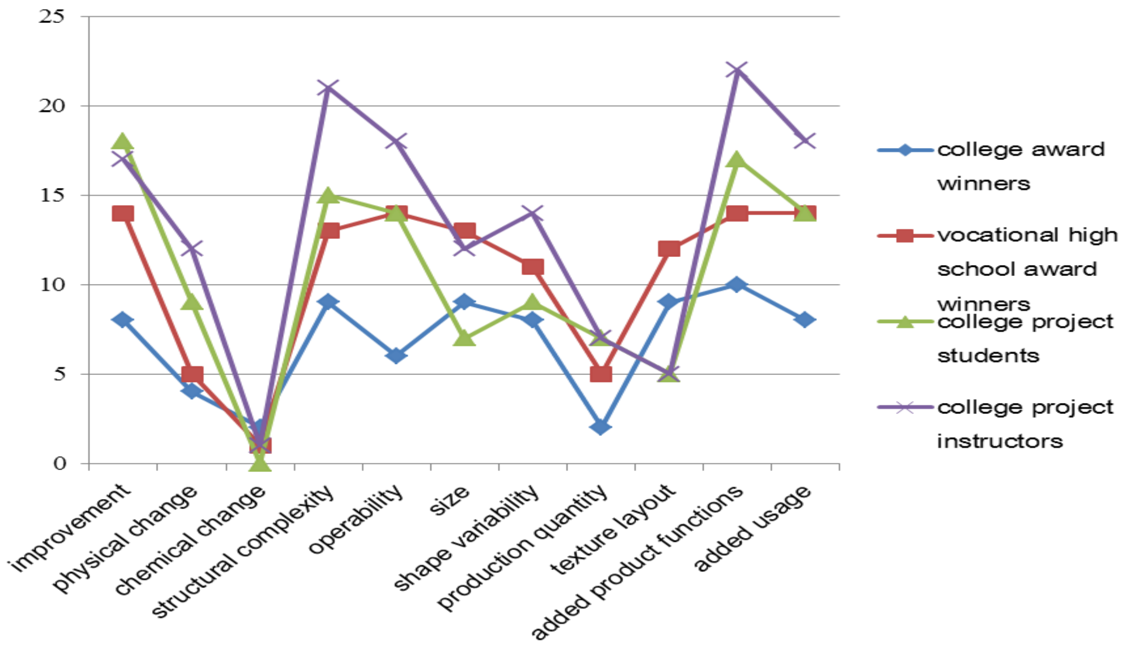

Figure 1 curve diagram of the innovative thinking points of different groups

Figure 1 shows the curve diagram of the innovative thinking points of different groups. The university/college of technology award winners possess the innovative thinking points with chemical change, while the various innovative thinking points of items are more even; the vocational high school award winners possess the innovative thinking points of size and texture layout; the university/college of technology project students possess the innovative thinking points of material improvement and production quantity; the university/college of technology project structures posses the innovative thinking points of physical change, structural complexity, operability, shape variability, production quantity, added functions, and added usage. Therefore, the innovative point curve of the groups varies considerably.

Conclusions and Recommendations

Based on the analysis results, it shows that the overall innovative thinking points are concentrated in the appearance, followed by function and mechanism. Possibly it is because the innovative thinking points can be brought into better play in the above-mentioned aspects. The total score of the innovative thinking points for different groups shows that the university/college of technology and vocational high school award winners' scores are higher than the scores of the university/college of technology project students and instructors.

The innovative thinking points can be viewed from different groups. The university/college of technology award winners are better able to utilize chemical change, but the overall innovative thinking points are more even. It is speculated in this study that the technical colleges' competition award winners have more all-rounded innovative thinking points. The vocational high school award winners are better able to utilize external size and external texture layout. The university/college of technology project students are better able to utilize material improvement and production quantity. The university/college of technology project instructors are better able to utilize physical change, structural complexity, operability, shape variability, production quantity, added function, and added usage. In view of this, innovative thinking points are broader for teachers that students. The implicit factors include: (1) Teachers are able to face students' diverse thinking loop of "individualized teaching"; (2) Teachers need to think ahead of students over multi-faceted problems. Teachers have more forward-looking creativity compared to students, which aids in student creativity development.

To sum up the above results, this study provided teaching suggestions for student learning and teaching. On the learning aspect, first, students, in addition to project work courses, can select implementation courses from related departments. Through "learning by doing" individuals' professional skills can be cultivated, materials and structures of professional fields can be learned, and students can get accustomed to the direction and development of their future work field. Moreover, students can participate in off-campus learning activities or creative implementation competitions to cultivate their vision, creative thinking with diversity and flexibility through activities. By continuously improving their ideas or works, their works will be more unique and practical. On the teaching aspect, first, teachers can lead students to view existing innovative products, such as visiting the ITRI's research development factories in related industries. Students will be able to broaden their horizons by paying visits. Secondly, theoretical courses can be incorporated into the implementation contents. Teachers will first lead students to operate and then request or encourage them to perform functional extension. In addition, students will be able to understand problems with existing product through case studies, and they will discuss how to improve or create new products that meet social demands. This way, student learning can be closer to everyday life, and they will be able to understand how to apply skills, thereby achieving deeper and broader development of the creative thinking aspect.

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