

An Empirical Analysis of the Innovation Ability Training for College Students

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Abstract: Innovation ability, the guarantee of development and the perfect display of individuality and ability, is the basis for us to find and solve problems. Taking the training painting ability of college students as an example, this study explores whether the training will improve the innovation ability in five aspects, namely, the fluency, originality, flexibility, sensitivity and insight of thinking, which is achieved by the design and implementation of painting courses that cultivate the ability of perception, imagination and expression. The research focuses on the research analysis and evaluation in the formation process of innovation capability, according to the thinking mode of forming innovation ability. Interfering the specific variables under the intervention of specific conditions, the study explores the interaction relationship of the key intellectual component of innovation ability, namely, perception ability, thinking ability and creative ability.

1. Introduction

Along with the development and progress of the society, whether people can win in competition depends on the creative thinking in education. The exploitation on innovation capability for individuals is an important national policy of many Western countries. In addition, it also recognizes the development of innovation capability as a strategic guarantee for the country to maintain a high level of vitality and rapid development. These countries researched and developed a full curriculum that inspires individual innovation capability and translate it into productivity. Nowadays, innovative talents have become the key to the rise and fall of the country's development. Compared with these economically developed countries, the gap between the research and cultivation of innovation ability is obvious. It is particularly urgent to strengthen the national innovation ability and make human resources in China become a real creative advantage.

This paper combines theory with practice using the experimental research method, which proves that the innovation ability can be improved through certain methods, and it also offers an alternative means for the cultivation of college students and the departments that need to improve their innovation ability.

2. Review of Related Theories

"Innovation ability" is also called creativity. The first "creativity psychology" study was initiated by F. Francis Galton, who first proposed the innovation ability of "genius theory" in 1869. In 1912, Schumpeter first proposed the basic idea of innovation theory, while Guilford proposed the concept of "narrow innovation capability" and "general innovation capability" in 1950, defining the innovation ability as an exterior capable behaviour, which paid attention to the individual thinking. Guilford believed that the narrow innovation capability refers to the ability to form creation, while the general innovation capability is creative personality. Moreover, he also pointed out that the innovation ability is not a single ability, but a relatively comprehensive ability composed of different capabilities.

Gruber and others believed that if people's emotions are integrated with knowledge reserves and motives, then the develop evolution type of creation ability can be formed. Csikszentmihalyi took the perspective of biological evolution and cultural evolution as the starting point. He thought that innovation ability is essentially the result of a cultural evolution, and the process of its production and evolution is highly similar to the process of biological evolution.

3. Research Design

This study selects the basic elements that influence the formation of innovation ability and constitute intelligence for experimental research testing. The main content of the study is art education, taking the innovation ability as P, the dependent variable, when A, B, C, D, and E are independent variables, I1, I2, I3, I4, I5, and I6 are sub-variables, and D1, D2, D3 are intervention projects. To study what role does each variable play and how it works in the formation of innovation ability, the experiment will be divided into the control group and the experimental group for prior and post testing, comparing variable intervention results of design. The control group did not intervene in after the test, and the experimental group will perform the interference. The experimental subjects will be selected from art majors and non-art majors, dividing into control group and experimental group for art professional students, and for non-art professional students. In order to achieve the relatively accurate comparison before and after the experiment, the basic conditions between the selected samples should be close, and the experimental subjects adopt cluster sampling. It is expected that many comprehensive colleges and art colleges will be selected for teaching experiments.

3.1 Research Framework and Hypotheses

Through the comparison between the experimental group and the control group, the students who participate in the experiment and those who do not participate are scored on the perceptive ability, imagination ability and expression ability in the painting operation, verifying whether the three abilities are improved, and testing the five aspects in the ability creation of experimental group and the control group. The five aspects include fluency, originality, flexibility, sensitivity and insight, and their related intelligence types respectively are logic to mathematical intelligence, natural to observational intelligence, communicating to contacting intelligence, visual to spatial intelligence and self-knowledge to self-examination intelligence. It also tests the correlation and effectively reveal the mechanism of the innovation ability of art education.

In this paper, the above five variables that influence the creation ability are set as dependent variables, and the intervention in the experiment is painting training. The abilities on perception, imagination, and expression, the independent variables, are what the tutorials for painting training include. These sub-items of the three variables include six perceptions, namely, the perception of the problem boundary, the perception of the surrounding environment in which the problem exists, the perception of the proportion of the relationship, the (visible observable) of the problem, and the (hidden) part of the shadow, the perception of the complete form of the problem, and the perception of effective training on divergent thinking and concentrated thinking.

What the hypothesis of this paper is to significantly improve students' creation ability in the fluency, originality, flexibility, sensitivity and insight of thinking, through the painting training on perceptual, imaginative and expressive ability.

3.2 Research Methods and Variables

With the longitudinal method and experimental method, the assignments of painting training are scored on the three abilities of perception, imagination and expression, examining the correlation between the improvement of these three abilities and the five dimensions of innovation ability, which is to reveal the mechanism for developing innovation ability through art education. In a controlled environment, the subjects are randomly divided into a test group and a comparison group, intervening the test group to measure and compare the results before and after the experiment.

Figure 1 Research Framework and Variables

4. The Research Results

4.1 Test

4.1.1 Difference analysis between the two groups before the experiment

Statistical methods: SPSS18.0 software was used for data analysis, adopt the t-test statistical

method, and the difference was statistically significant at $P < 0.05$ (bilateral).

The test compared the differences between the experimental and control groups of five sub-variables in innovation ability before the experiment. The results showed no significant difference between the two groups and were suitable for comparative experiments.

4.1.2 Difference analysis of experimental group before and after the experiment

In this paper, an independent sample t-test method was used to compare the differences between the experimental and control groups of five sub-variables in innovation ability before and after the experiment. The results showed significant differences before and after the experiment. The t values respectively are -19.984, -17.996, -13.767, -19.470, and 13.679, while the P values are < 0.001 , < 0.001 , < 0.001 , < 0.001 . (Table 3), which shows the significant improvement of students' innovation ability through the intervention of painting training. Among them, the change of sensitivity is the most significant, indicating the obvious improvement on the visual to spatial intelligence associated with it. The second is insight, the type of intelligence involved, namely the self-knowledge and self-examination intelligence.

Table 1 Comparison on scores of each dimension in the experimental group before and after the experiment

	Mean	N	Std.Deviation	t值	P值
Fluency before experiment	5.0568	88	2.42287	-19.984	< 0.001
Fluency after experiment	9.4432	88	1.70097		
Flexibility before experiment	6.7273	88	1.90418	-17.996	< 0.001
Flexibility after experiment	8.8636	88	1.51757		
Sensitivity before experiment	2.6092	87	2.42255	-13.767	< 0.001
Sensitivity after experiment	7.9310	87	2.12840		
Originality before experiment	3.8295	88	1.50265	-19.470	< 0.001
Originality after experiment	6.0227	88	1.23155		
Insight before experiment	5.2727	88	2.10488	-13.679	< 0.001
Insight after experiment	8.1591	88	2.11664		

4.1.3 Difference analysis of the control group

In this paper, an independent sample t-test was used to compare the differences between the five sub-variables on innovation ability of the control group in the prior and post experiment. There were no significant differences before and after the experiment, indicating that the two tests themselves will not interfere with the test results.

4.2 Painting training

SPSS18.0 software was performed in data analysis, and the paired t-test statistical method was used also. The difference was statistically significant at $P < 0.05$ (bilateral).

4.2.1 Difference analysis

(1) Difference analysis between the two groups before the experiment

In the dimensions of perceptual ability, imagination ability and expression ability, the results of sample t-test show that the comparison t-values of the two groups before the experiment respectively are 1.731, -1.283, and 0.852, and the corresponding value P is greater than 0.05. The differences have no statistical significance, which means that in the dimensions of perceptual ability, imagination and expression ability, there is no significant difference between the two groups before the experiment.

(2) Difference analysis between the two groups after the experiment

Table 2 Comparison on the scores of painting ability between the two groups after the experiment

After the experiment	Grouping	N	Mean	Standard deviation	Value T	Value P
Perception ability	Control group	48	72.88	9.25	-3.460	0.001
	Experimental group	88	78.7	9.44		
Imagination ability	Control group	48	61.06	15.44	-8.063	0.000
	Experimental group	88	80.69	12.44		
Expression ability	Control group	48	67.3	9.44	-5.093	0.000
	Experimental group	88	75.34	8.43		

In the dimensions of perception ability, imagination and expression ability, the t-test results show that the comparison t values of score in the two groups after the experiment respectively are -3.460, -8.663, -5.993, and the corresponding value P is less than 0.05. The difference has statistical significance, which means that in the dimensions of perceptual ability, imagination and expression ability, the score of experimental group is higher than the control group after the experiment.

(3) Difference analysis before and after the experiment in the control group

In the dimensions of perception ability, imagination ability and expression ability, the results of paired t-test show that the comparison t-values of the control group before and after the experiment respectively are -0.489, 0.215, -0.592, and the corresponding value P is greater than 0.05. It means that in the dimensions of perception, imagination, and expression ability, there is no significant difference in the scores of the control group before and after the experiment.

(4) Difference analysis of experimental group before and after experiment

Table 3 The scores on the painting ability before and after the experiment in the experimental group

Experimental group	Grouping	N	Mean	Standard deviation	Value T	Value P
Perception ability	Before the experiment	88	69.06	8.05	-7.289	0.000
	After the experiment	88	78.7	9.44		
Imagination ability	Before the experiment	88	66.02	17.48	-6.414	0.000
	After the experiment	88	80.69	12.44		
Expression ability	Before the experiment	88	64.06	13.42	-6.677	0.000
	After the experiment	88	75.34	8.43		

In the dimensions of perceptual ability, imagination, and expression ability, the results of the paired t-test from the above Table show that the scores of the comparison t value in experimental group before and after the experiment respectively are -7.289, -6.414, and - 6.677, and the corresponding value P is less than 0.05. The difference is statistically significant. It means that in the dimensions of perceptual ability, imagination and expression ability, the score of the experimental group after the experiment is higher than before. Among them, the change of imagination is the most significant.

4.2.2 Correlation analysis of the increased value of each dimension of the experiment after the experiment

Table 4 Correlation analysis of the improvement values of each dimension and ability experiment

		Fluency	Originality	Flexibility	Sensibility	Insight improvement
Conception ability	correlation coefficient	-.012	-.006	-.005	.007	-.013
	Value P	.602	.790	.834	.755	.568
Imagination ability	correlation coefficient	-.004	-.021	.027	.044	.012
	Value P	.870	.350	.251	.056	.614
Expression ability	correlation coefficient	.027	.011	.018	-.075	-.115
	Value P	.239	.624	.560	.801	.091

(* indicates that the value P is less than 0.05, ** indicates that the value P is less than 0.01)

The results of the above Table analysis show that there is no significant correlation between the

improvement of perception ability, imagination ability and expression ability after the experiment in the control group ($P>0.05$).

5. Conclusions and Limitations

5.1 Analysis of conclusions

Through the design and implementation of painting courses such as sketch, color, creation and other painting training, it guides the basic knowledge of art and cultivates the perception, imagination and expression for students, which will significantly improve students' perception ability of problem boundaries, the perception ability of the problems existed in the surrounding environment, the perception ability of the proportion of relationships, the perception of the problem (visible and observable) and the (hidden) part of the shadow, even the perception ability, divergent thinking and concentrating thinking of the complete form of the problem has also improved significantly.

The five factors of innovation ability also improved significantly after the improvement of seven sub-items on the perception ability of the problem boundary, and perception ability on the surrounding environment of the problem.

The five major factors cultivating the formation of thinking and innovation ability, directly improved the creative ability. Due to the three aspects of improving the perception, imagination and expression of the painting course, namely the sketch, color, creation and other painting training, it has gone through complete preparation, gestation, opening and verification period. This is consistent with the process of creative ability formation, and has achieved the thinking ability. Moreover, it developed good observation habits, formed a special knowledge accumulation ability, and improved the expression ability.

5.2 Limitations

The research, a combination of education and management, has defects in the fusion of the research methods of the two disciplines, due to the two distinct disciplines, therefore, it should be made up in this respect. At the same time, the study should further expand the scope of the experiment for verification, because the experimental methods and objects are relatively single, and the coverage of the research object is not large enough. Moreover, there can be more extensive innovations in research methods. The composite research using various research methods makes the research results of innovation ability more credible. In academics, the content of art coverage is extremely wide. In addition to the art categories selected in the experiment, the research will be extended to further research on music, dance and other disciplines. On this basis, deep integration with management, forms a management research paradigm that specializes in the field of art. Researchers believe that such research will be more practical and more acceptable to the academic community.

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