



A Study on the Effect of Virtual Reality 3D Exploratory Education on Students' Creativity and Leadership

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Received 23 October 2016 • Revised 15 February 2017 • Accepted 29 March 2017

ABSTRACT

Applying education ideas and concepts to education sites, through good educational policies, to complete education tasks is important for developing personal potential. Centered on students, educational objective is to cultivate multiple talents for the future society. In such a rapidly changing era, limited knowledge is not enough to cope with challenge in future societies. In other words, the knowledge possessed presently could not solve the problems faced in the future. The nonequivalent pretest posttest control group design model is utilized in this study. Total 104 students in two classes in Chang Jung Christian University, Taiwan are experimented. The research results show (1) significant effects of exploratory education on creativity, (2) the optimal creativity promoted by exploratory education with virtual reality, (3) remarkable effects of exploratory education on leadership, and (4) the optimal leadership enhanced by exploratory education with virtual reality. Finally, suggestions are proposed according to the research results, expecting to educate students, with technology, to open the door of creativity and leadership.

Keywords: virtual reality 3D, creativity, leadership, sensitivity, flexibility

INTRODUCTION

Education determines talents, and talents decide the future of the world (Gordon, 2011). Qing-Shan Wu and Hsu et al. (2013) revealed that good educational policies were important for applying education ideas and concepts to education sites to complete education tasks and develop personal potential. Lin et al. (2013) further indicated that the educational objective, centered on students, was to cultivate multiple talents for future societies. In the rapidly changing era, limited knowledge is not enough to cope with the challenge in future societies.

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State of the literature

- In 3D virtual reality, the interaction with computers is expanded from purely visual interaction to diverse interaction, where users could apply perceptual experience and cognitive processing ability.
- Exploratory education originally was simplifying adventurous outdoor activity of a school into activity courses practicable in the school with simple teaching aids.
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Contribution of this paper to the literature

- The Virtual Reality 3D exploratory education evaluation and improvement could enhance the research effect and expand the practicability of the course.
- Adding virtual reality 3D to exploratory education also proves that experience, better than text, allows a person more easily generating learning attitudes and motivation to further change the behavior.
- It is full of observation, communication, cooperation, reflection, and self-clarification in Virtual Reality 3D exploratory education activity; and, the one-time leadership and led thinking and model as well as some creative problem-solving could not be actually measured with pencil-and-paper tests.

That is, the knowledge possessed now could not solve problems faced in the future. "Creativity" is an essential ability for people at present and in the future as well as the key success factor in nurture and school teaching (Baena-Extremera et al., 2012). As a result, people have to apply creativity to solve problems which they face now and in the future. People expect that students would feel the fun of learning experience in schools; in fact, school curricula, according to students, are lack of the acquisition of mental ability and the development of creativity (Wong et al., 2012). For children in such a generation, "future globalization competition is a trend, and creativity training could assist children in adapting to the changeable situation and getting rid of difficulties." The possession of creativity allows effectively solving problems and enhancing the quality of life (Lin et al., 2013). People should not constrain the original creativity of children, but help them expand and deepen the experience during the growth. When children's "self-actualization creativity" is reinforced, their ability to cope with changeable situations in the future is beyond the imagination. With digital technology, the separation from the world is reduced to become "closer". Nevertheless, technology would not tell people how to apply technology; merely people with creativity could open the door of future (Yorio & Feifei, 2012). Open the door of creativity for children and believe that education could largely help children adapt to the society.

LITERATURE REVIEW

Virtual reality 3D

Birsen Bagceci & Battal Odabasi (2013) considered that virtual reality, under the combination of computers and peripheral equipment, allowed users being in the 3D space created by computer models. In 3D virtual reality, the interaction with computers is expanded from purely visual interaction to diverse interaction, where users could apply perceptual experience and cognitive processing ability, as in the real world, to interact with objects in virtual reality and browser the feelings similar to the changes in the natural world (Gordon, 2011). Amber et al. (2013) indicated that virtual reality allowed users observing the virtual world from any aspects, and any objects in the virtual world could interact with the users. Virtual reality constructs a believable situated world through computer science technology, converts the entity in the physical environment and digital data into viewable and even touchable 3D virtual scenes, and matches with man-machine interface operation to turn people into the direct participants in the virtual world, as in the real environment. Eenfield & Gregg (2013) pointed out virtual reality as a virtual world allowing users observing from any aspects and users being able to interact with any objects in the virtual system.

Lin et al. (2013) proposed three elements of immersion, interaction, and imagination, as “3I’s” in virtual reality, to construct a virtual reality situation.

- (1) Immersion. Immersion referred to the virtual reality situation allowing users perceiving the function of “being immersive” and integrating in the virtual world simulated by virtual reality.
- (2) Interaction: Interaction was the interaction and feedback between users and the virtual situation. The sensory stimulation and response in the situation were important and necessary for a virtual reality system; regardless any man-machine interface, the system had to make responses to users in the shortest time in the human-computer interaction process and have users perceive the responses in the simulation situation.
- (3) Imagination: Imagination, as the direction to construct virtual reality, was a fabricated simulation situation. In addition to allowing users fully perceiving the sound and light stimulation, the situation design and object attribute could be full of imagination.

Exploratory education

Breault (2013) mentioned the similar properties of common Outward Bound (OB), Project Adventure (PA), Adventure-Based Counseling (ABC), and Experiential Education (EE). Although the goals and development methods were slightly different, they were learning methods initiated from experience spirit. Huang et al. (2012) pointed out the adventurous, exploratory, experiencing, and unusual meanings of “adventure” that it was defined as “exploratory”. In spite of the different names of “exploratory education”, “experiencing education”, “adventurous education”, “outdoor adventurous education”, “adventure-based

recreation”, “team development”, or “outdoor adventurous teaching”, the basic spirit of using experience-based learning and having participants participate in the activity experiencing and introspect the activity experience was about the same. The activity presented high interest, low obstruction, and high inspiration that it could enhance the development of participants’ personality (Baena-Extremera et al., 2012). Exploratory education originally was simplifying adventurous outdoor activity of a school into activity courses practicable in the school with simple teaching aids, or even without teaching aids (Hsu & Shih, 2013). It was applicable to various workshop, camp activity, general course, or professional training, and the content was getting richer to become a trend. With education and training in enterprises, the practice in school curricula, and the establishment in various experiencing and recreational sites, exploratory education is developed richer and more diversified in Taiwan.

Creativity

Creativity is a diversified and complicated construct (Daniel et al., 2014). Hsu & Shih (2013) regarded creativity as the ability of people with excellent creativity, responding that people considered creativity as the intuitive view of ability. Jim Sibthorp & Jeremy Jostad (2014) concluded the meanings of creativity in studies on creativity and drew the definition, which could be executed in the education process, as an individual, under supportive environment, combining the characteristics of sensitivity, fluency, originality, and elaboration and giving unique and novel meanings to affairs with divergent points of view through thinking processes so that the results satisfied both oneself and others. A lot of researchers have discussed the idea of creativity. Beightol et al. (2012) proposed the commonly agreed definition that creativity referred to create new and useful products, including concepts and specific articles. Most researchers defined creativity with the “product” of creativity. Ewert & Sibthorp (2014) proposed 4P of creativity to integrate the research area of creativity and considered to study creativity from the directions of 1.creative product, 2.creative person, 3.creative process, and 4.creative place (Paquette et al., 2014).

Hsu & Shih (2013) regarded creativity as the most precious treasure in human brains and the foundation of future and divided it into sensitivity, fluency, flexibility, originality, and elaboration. The training effect of such five abilities in the creativity training is briefly described as below.

- (1) Sensitivity: Sensitivity allows students grasping key points and the key in solving problems when studying or preparing for examinations.
- (2) Fluency: Fluency allows students thinking fluently, coming out with solutions to solve problems, and writing smoothly.
- (3) Flexibility: Flexibility allows students not getting into dead ends when encountering difficulties and being able to “make changes when all means are exhausted and emerge a solution when changes are made”.

- (4) Originality: Originality allows students having personal unique opinions and fulfilling the original characters.
- (5) Elaboration: Elaboration allows students planning in detail, considering thoroughly for solving problems, and often making checks, without being careless.

Leadership

Hsu et al. (2013) claimed that a leader mainly conformed vision to establish the direction, had the employees understand through communication, and encouraged them to move toward the organizational goal. Durand-Bechu et al. (2014) proposed leadership as a leader applying distinct influence in the group interactive behavior and inducing the members' wisdom and ability to cooperatively fulfill group common ideal and goal. Kelsey Deane & NikiHarr'e (2013) regarded leadership as the interpersonal interaction program influencing the behaviors of a person or a group of people under specific situations to achieve the group goal. Besserer & Caron (2013) also defined leadership the art that a leader set an example to have the others be willing to strive for the common vision. Leadership is to constantly challenge current situations, enhance employees' enterprise, establish trust among people, and protect the naturally common moral foundation. Leadership is a program having organizational members work for achieving the group goal (Fulford & Thompson, 2013). Hsu et al. (2013) indicated that leadership could be trained, but the characters of leadership needed to be discovered. Lee & Ewert (2013) proposed the important abilities of a leader as presenting excellent language skills, being able to tell stories, showing smooth writing and good interpersonal relationship skills, presenting introspection and perception, emphasizing existing problems, and being able to help people understand their living conditions and goals.

Referring to Kolb (2014), leadership is divided into three characters in this study.

(1) Motivation ability: including enterprise, vitality, and the willingness to strive for leadership, covering analytic ability, organizing and planning ability, communication ability (including oral and written expression), decision-making ability, and problem-solving and creativity.

(2) Interpersonal skills: containing interpersonal sensitivity, affinity, persuasiveness, perception of social situation, relationship with authorities, types of leadership, and first impression to people.

(3) Personality traits: covering self-confidence, frustration tolerance, initiative, persistence, responsibility, and trustworthiness and stressing on individual psychological strength.

RESEARCH HYPOTHESIS AND DESIGN

Research hypothesis

Severino & Messina (2010) discussed creativity through exploratory education. The experiment result showed that the experimental group outperformed the control group on

creativity affective traits, such as adventure, curiosity, and challenge, and creativity cognitive ability, like opening force, precision, and title. Law & So (2010) studied the effect of the intervention of inspiring games in physical education class on junior high school students' creative thinking that inspiring games could significantly enhance junior high school students' creativity tendency and creativity cognition ability. The inspiring games referred to "inspiring game activity" proposed by the USA in 1971 (Steinberg, 2011); it is the exploratory education activity mentioned in this study. In the mobile research result, Rhodes & Martin (2013) revealed that students participating in the exploratory education activity program could affirm themselves and appreciate others, enhance teamwork and induce creativity, objectively solve problems, and apply what they learned to daily life. Yorio & Feifei (2012) analyzed the effect of exploratory education activity on junior high school students with different background and discovered that exploratory education activity could enhance junior high school students' ability to prevent problems and help the problem-solving skills and team interaction skills; junior high school students tended to positive experience in the perceived exploratory education activity; and, teachers could help the professional growth by practicing exploratory education activity.

H1: Exploratory education shows remarkable effects on creativity.

H2: Using exploratory education under virtual reality appears the optimal effect on the promotion of creativity.

Richards et al. (2013) studied the effects of the exploratory education activity program on junior high school students in gifted classes; Hsu et al. (2013) researched the effect of exploratory education activity on the promotion of elementary school gifted students; Sibthorp & Morgan (2011) studied the teaching effect of leadership ability on elementary school gifted students; and, Paquette et al (2014) researched teenagers' experience in participating in exploratory activity. The above studies showed the notably positive effects of exploratory education activity on the cultivation of leadership ability. Wong et al. (2012) indicated that the practice of "exploratory education activity" could enhance gifted students' leadership ability, where the students in the experimental group presented stronger motivation and action force in real tasks. Kelsey Deane & NikiHarr'e (2013) mentioned that "exploratory education activity" could promote gifted students' leadership ability and emotional intelligence. "Exploratory education activity" could also promote the inclusiveness, self-confidence, thinking ability, and response that the course experience could help the future group life.

H3: Exploratory education reveals significant effects on leadership.

H4: Using exploratory education under virtual reality shows the optimal effect on the promotion of leadership.

Table 1. Variance Analysis of exploratory education and creativity

	Variable	F	P	Scheffe post hoc
Exploratory education	Sensitivity	9.662	0.001**	Exploratory education>traditional type
	Fluency	6.533	0.000**	Exploratory education>traditional type
	Flexibility	10.523	0.002**	Exploratory education>traditional type
	Originality	8.637	0.000**	Exploratory education>traditional type
	Elaboration	12.416	0.000**	Exploratory education>traditional type

* stands for $p < 0.05$, ** for $p < 0.01$

Research subject and research design

To effectively achieve the research objective and test the research hypotheses, the nonequivalent pretest posttest control group design model is utilized for the quasi-experimental design in this study. Total 104 students in two classes in Chang Jung Christian University, Taiwan as the research subjects, are regarded as the experimental class (52 students) for the creative thinking teaching and the control class (52 students) for the traditional type of didactic teaching. The experimental teaching is preceded three hours a week for 32 weeks (total 96 hours). The first 16 weeks are taught without virtual reality, and the last 16 weeks are integrated with virtual reality.

Analysis method

Analysis of Variance is applied in this study to discuss the effect of exploratory education on creativity and leadership and further understand the effect of exploratory education matching with virtual reality on creativity and leadership.

ANALYSIS AND RESULT

Variance Analysis of exploratory education and creativity

Analysis of Variance is applied to discuss the effect of exploratory education on creativity. From **Table 1**, exploratory education and the traditional type show remarkable differences on sensitivity, where exploratory education appears higher sensitivity than the traditional type; exploratory education and the traditional type reveal notable differences on fluency, where exploratory education presents higher fluency than the traditional type; exploratory education and the traditional type show significant differences on flexibility, where exploratory education reveals higher flexibility than the traditional type; exploratory education and the traditional type present remarkable differences on originality, where exploratory education appears higher originality than the traditional type; and finally, exploratory education and the traditional type show notable differences on elaboration, where exploratory education reveals higher elaboration than the traditional type. H1 is therefore supported.

Table 2. Variance Analysis of exploratory education and leadership

	Variable	F	P	Scheffe post hoc
Exploratory education	Motivation ability	11.273	0.003**	Exploratory education>traditional type
	Interpersonal skills	13.568	0.000**	Exploratory education>traditional type
	Personality traits	10.921	0.000**	Exploratory education>traditional type

* stands for $p < 0.05$, ** for $p < 0.01$

Table 3. Variance Analysis of exploratory education in statistical learning achievement

Variable	Creativity			Leadership		
	F	P	Scheffe post hoc	F	P	Scheffe post hoc
Exploratory education	22.378	0.000**	exploratory education>traditional type	26.551	0.000**	Exploratory education>traditional type
Virtual reality	18.426	0.000**	exploratory education>traditional type	19.415	0.000**	Virtual reality>traditional type
Exploratory education*virtual reality	36.207	0.000**	11>21>12>22	44.513	0.000**	11>12>21>22

* stands for $p < 0.05$, ** for $p < 0.01$

Variance Analysis of exploratory education and leadership

Analysis of Variance is applied to discuss the effect of exploratory education on leadership. From **Table 2**, exploratory education and the traditional type present significant differences on motivation ability, where exploratory education shows higher motivation ability than the traditional type; exploratory education and the traditional type reveal remarkable differences on interpersonal, where exploratory education appears high interpersonal skills than the traditional type; and, exploratory education and the traditional type show notable differences on personality traits, where exploratory education reveals higher personality traits than the traditional type. Consequently, H3 is supported.

Analysis of the effect of virtual reality integrated exploratory education

The effect of virtual reality integrated exploratory education on creativity and leadership is discussed with Analysis of Variance, and the interaction between virtual reality and exploratory education is tested with two-factor Analysis of Variance to test the promotion effect on virtual reality. From **Table 3**, the highest creativity and leadership appear on exploratory education with virtual reality that H2 and H4 are supported.

CONCLUSION

This study discusses the effects of creative thinking teaching on students' creative thinking ability. The results reveal that the properly designed experimental courses train leaders leading the members to complete a series of nervous, fierce, but achievable tasks or

team goals and develop the base on experiential learning for generalization, reflection, and application to achieve the perceived self-value, learn leadership, and communicate the behaviors to change the teaching model or learning model. Adding virtual reality to exploratory education also proves that experience, better than text, allows a person more easily generating learning attitudes and motivation to further change the behavior. Especially, it could lead people leaving comfortable areas for challenging self-boundary and could more easily touch people. It is why exploratory education is so attractive. The original adventurous outdoor activity is simplified into activity courses practicable in schools with simple teaching aids, or even without teaching aids. Apparently, exploratory education could have a person generate such positive perception and further enhance self-concept and change interpersonal interaction. Moreover, experiential education is a primary theory of learning, in which the members grow in the learning experience and a leader complete in the experiment. Meaningful experience is acquired from the selection and decision practice; a leader constantly makes progress in team development, situated leadership, and leadership styles.

SUGGESTION

1. The exploratory education activity program should be carefully planned to improve unfavorable courses and establish systematic exploratory education activity courses and could add warming activity or games allowing the members understanding the goals of each other and confirming the team goal. After inducing the interests, the contract with comprehensive value is further made to help individuals in the team stating the goals and forming the team goal and to promote the consensus striving for the goal. It would be more efficient for the absorption of learners. The program evaluation and improvement could enhance the research effect and expand the practicability of the course.
2. Increasing various reflection methods or using reflection tools could enhance the members' willingness to sharing and listening to experience and perception, such as diary writing, emotional exploration, drawing, and being alone, as well as promoting the participation in the courses. As suggested by the observers, more activity methods and rewards could be used through reflection dice and reflection cards to have the students unconsciously speaking out the reflection content. Besides, the conditions which a leader just discovers in the activity could be added to have the students discuss and think back.

It is full of observation, communication, cooperation, reflection, and self-clarification in exploratory education activity; and, the one-time leadership and led thinking and model as well as some creative problem-solving could not be actually measured with pencil-and-paper tests. The researchers therefore suggest increasing peer assessment to record participants' viewpoints about the peers so as to become a tool analyzing group dynamic and leadership styles.

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