Design Thinking Applied to Advertising Design Courses to Enhance Students' Learning Achievement

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The Southeast Asian Conference on Education 2021
Official Conference Proceedings

Abstract
At the time when technology is booming, the definition of advertising is no longer advertised through traditional mass media, but a trend that everything is advertising. Advertising design is not just about creating beautiful and emotional content. It must be customer-centric to make consumers feel that advertising is meaningful and worthy of action. In Taiwan, traditional design education focuses on teaching professional skills, but lacks the exploration and thinking of design issues, as well as the cultivation of students' self-thought and values. In this study, 48 students from the advertising design course were randomly divided into 13 creative teams by convenience sampling. The teaching experiment was carried out through the control-group-treatment-group design, the control group implemented the formal teaching, and the treatment group implemented the design thinking method proposed by Stanford University. This study aimed to find out whether design thinking can improve students' learning achievements in advertising design and whether it interacts with learning achievements under the mediation of empathy, define, ideate, prototype and test. The results can provide advanced advertising design and serve as a reference for teaching design-related courses.

Keywords: Augmented Reality (AR), Advertising Design, Design Thinking, Design Education

Introduction

Design education originated from art education, and talent incubation in this domain revolves around teaching forms, materials, and technical skills (Chao, H. L. & Kao, C. F., 2017). A survey on advertising design education in Taiwan indicated that it is based on lecturing theories, followed by manual practice. Students often fail to understand the connection between theory and practice; this is the source of the long-term problem of what teachers teach and what students actually learn. The maturation of the Internet and advanced digital technology have altered the ecology of advertising message dissemination. Advertising is no longer defined as informing through the expansiveness of traditional mass media but rather represents a trend of "everything is advertising." Advertising strategies are oriented toward an integrated communication design for comprehensive marketing, and the aspects considered have become extremely complicated. In practice, advertising design implies characteristics of marketing and brand design; the design content and purpose involve advertising and marketing theories, creativity, visual style, media communication, new digital thinking, and technology (Zhu, J. X., 2017). Advertising design combines marketing strategy with creativity. The objective of this study was to transform the traditional model of advertising design courses and enhance students' understanding of advertising design.

Regarding current teaching approaches to advertising design, instructors tend to focus on visual communication in advertising. Students are trained to present refined graphic forms and styles. Lacking creativity in shaping the uniqueness of a brand, students generally tend to explore brand elements through overly linear and one-dimensional thinking and fail to integrate needs related to society, the environment, the market, or target users into the design in a diverse, multidimensional manner (Gong, S. Z., 2013). Advertising design education should veer toward innovative methods of design teaching. Design thinking is generally defined as an analytic and creative process. Participants form insights regarding consumer needs and design through experience, observation, feedback, and prototype experimentation. Valued in both academia and industry, design thinking is widely used by companies to address commercial and societal issues. However, applying design thinking to design teaching and thus influencing student learning achievement has rarely been studied (Tu, Liu, & Wu, 2018). Design thinking is a methodology based on innovative thinking (Melles, Howard, & Thompson, 2012) and a type of creative thinking pertaining to sentiment analyses (Razzouk & Shute, 2011). Traditional analytic thinking pertains to rational thinking, whereas design thinking is more human-centered; it helps designers gain insights into consumer mentality, penetrate the real needs of consumers, and suggest reasonable design ideas that consider such needs (Dunne & Martin, 2006; Yang & Hsu, 2020). Therefore, this study used methods of design thinking to train the students in advertising courses to reflect on advertising design in multidimensional ways to enhance their sense of achievement in learning advertising design.

In Taiwan, fostering student creativity is an orientation in pedagogical development and an approach to enhancing national competitiveness. In operating auxiliary tools for design thinking, the student participants were guided to perceive consumer needs, which facilitated creativity development and model testing, thus achieving design performance that met consumer needs. This study analyzed whether design thinking-based teaching methods affected the effectiveness of learning augmented reality-based advertising design and whether design thinking-based teaching mediated by "empathy," "define," "ideate," "prototype," and "test" affected learning results.

Literature Review

Teaching of Advertising Design in the Digital Age

Advertising is a major form of commercial promotion and an effective means of conveying commercial information. Following developments in science and technology, concepts in contemporary advertising have shifted greatly. Advertising design extensively incorporates theories from social science, economics, aesthetics, marketing, psychology, communication science, and statistics. The boundless creative possibilities of advertising which, combined with technology, have made thinking-oriented advertising design much more challenging (Burke et al., 1990). Only advertisements giving rise to unique ideas and commercial value can stand out and attract consumer attention. Training in traditional advertising design courses focus on craftsmanship. Students with favorable execution skills can create a beautiful advertisement design that, nevertheless, may fail to consider actual market and consumer needs. Regarding advertisement design performance in the digital age, Gong J. R. (2017) indicated that it is not characterized only by logical and persuasive messaging; exquisite techniques developed from combining artificial intelligence and technology have also given rise to production modes that are beyond traditional advertising design. Advertisements should be concerned with perceiving human nature and consider flow and participants' user experience with particular platforms; an advertisement designed with consideration of human aspects corresponds more closely with consumer needs. Griffin (2008) investigated advertising students at two universities and developed an advertising design teaching mode to study the differences in the creative processes of beginner and advanced students; the results confirmed differences that existed in their creative processes. The advanced students often re-examined their thoughts, which gave rise to more resources in their thinking process. Execution was absent from their descriptions of the creative process. For a creative thinker, insight allows mastering the orientation of a process, which contributes to idea generation.

Waarde and Vroombout (2012) proposed nine reflections for those formulating design education strategies: (1) consider visual configurations; (2) consider the situation; (3) consider the problem; (4) consider perspective; (5) consider modification for production; (6) consider evaluation and testing; (7) consider presentation and argumentation; (8) consider operational planning and execution; and (9) consider personal development.

A successful advertisement must be novel, interesting, and innovative; at the same time, it should be functional and reasonable to meet customer demands and achieve the goal of communication (Cheung, 2011). The act of advertising design is a problem-solving process using technical skills with considerations regarding aesthetics, social issues, culture, and consumer needs. Based on the relationship between advertising education and industry, Johnson and Jones (2010) suggested that the speed of digital marketing reform has surpassed that of the cycles of pedagogic adjustment in schools, but companies expect graduates to showcase creativity and technical execution skills nonetheless. Design education should evolve with time, and the courses that incubate advertising design talents should combine both conceptual thinking and technical skills to confront the frequent changes in our environment regarding the demands for advertising design and the career expectations of talents required by the industry (Habib, 2015). Based on the aforementioned aspects, Hypothesis 1 (H1) was formulated as follows:
H1: Design thinking-based teaching positively affects learning achievement.

Design Thinking

Design thinking is a design method for applying and fostering creativity. The method was initially used by architects and urban planners to reflect on issues (Rowe, 1987). Later, it was introduced by David Kelley, the founder of the design company IDEO, into the field of industrial design. Based on a designer's understanding and sensitivity regarding a problem, aspects of the problem are integrally considered to inspire reflection on the feasibility of solutions and to obtain complete concepts regarding innovative issues (Brown, 2009). The Institute of Design at Stanford University proposed the following five steps of design thinking: (1) "empathy": understanding the user before solving a problem and thinking about user needs from the user's perspective and through empathy; (2) "define": classify the collected data, identify key issues, and clearly define each issue; (3) "ideate": seek feasible solutions through brainstorming; (4) "prototype": make semi-finished products by hand and actually simulate any problem regarding the creative imagination and the prototype; and (5) "test": after a prototype is completed, revise it according to user feedback following user tests (Plattner, 2010). Figure 1 depicts these five steps of design thinking.

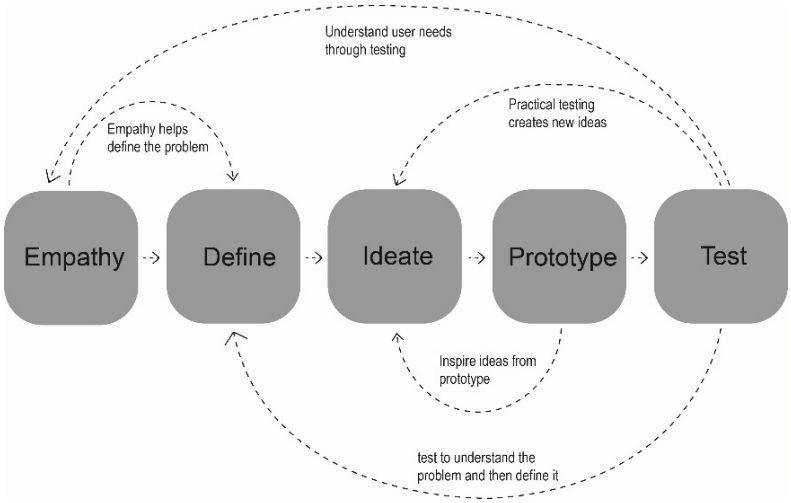

Figure 1: The Five Steps of Design Thinking.

Razzouk and Shute (2011) suggested that design thinking is a method for proposing solutions to a problem through group discussion. Hawryszkiewycz (2013) proposed that the design thinking-based method differs from "traditional" analytic thinking. It is based on creative and intuitive thinking. Analytic thinking is a part of design thinking; design thinking requires both logical force and creativity to combine analytical thinking, intuitive thinking, and creative thinking in an innovation process (Bauer & Eagen, 2008). Dunne and Martin (2006) argued that design thinking integrates the ideas of group members, and the optimal solution is obtained through team collaboration; it can be used in product creation, organizational management, and solving social challenges. Tu, Liu, and Wu (2018) used action research based on dialog and interviews with14 students in a design institute. They also used questionnaires, records, and triangulation to investigate how learning effectiveness was affected by introducing design thinking into design courses. Their findings indicated that in-depth discussion of design issues was enhanced by exploring tool operations and understanding the needs of target groups, which also improved the classroom atmosphere for learning and facilitated design teaching. Based on the aforementioned arguments, the following hypotheses were advanced:

Hypothesis 2 (H2): Empathy-mediated design thinking-based teaching affects learning achievement;

Hypothesis 3 (H3): Define-mediated design thinking-based teaching affects learning achievement;
Hypothesis 4 (H4): Ideate-mediated design thinking-based teaching affects learning achievement;
Hypothesis 5 (H5): Prototype-mediated design thinking-based teaching affects learning achievement; and
Hypothesis 6 (H6): Test-mediated design thinking-based teaching affects learning achievement.

Research Method

Experimental Design

This study investigated whether student design performance was positively affected by introducing design thinking-based training into design teaching, operating design thinking by following relevant steps, and designing augmented reality advertising, and whether this further led to positive learning achievement. The independent variable was teaching mode used with the control group and the treatment group; the mediating variables were satisfactions with design thinking based on "empathy," "define," "ideate," "prototype," and "test"; the dependent variable was learning achievement. The study structure is presented in Figure 2.

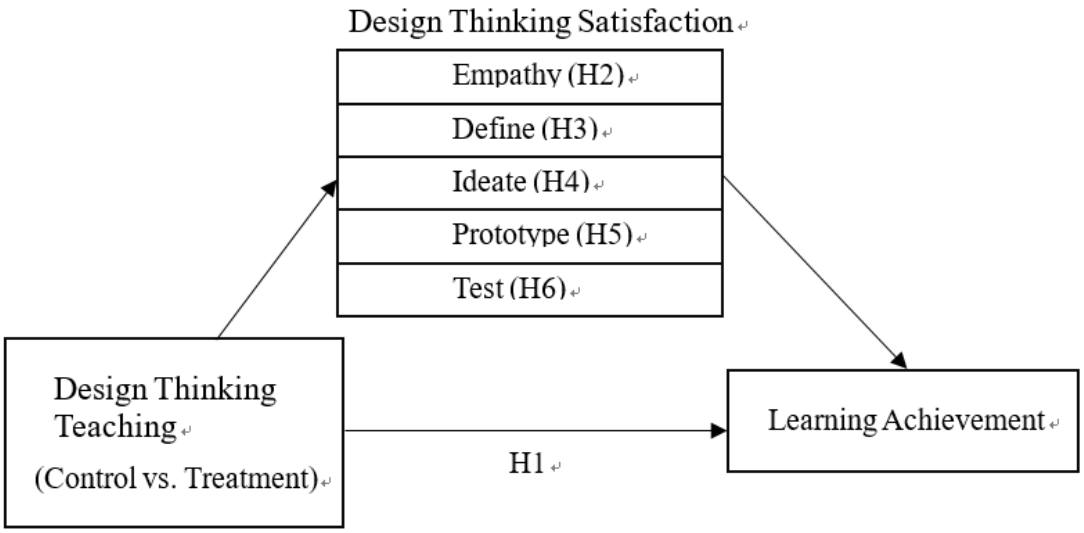

Figure 2: The Experimental Framework

Participants and Procedure

Convenience sampling was used to recruit a total of 48 third-year students (7 men and 41 women) interested in enrolling in an advertising design course of the Commercial Design Dept. of Ming Chung University. The participant students were randomly divided into 13 groups each with 3 to 5 members. At the beginning of the teaching experiment, the students were informed of the course learning objectives and teaching methods; the students were allowed to stop and abstain from participating in the experiment. The study procedure complied completely with ethics in academic research. The course-experiment was conducted in two stages. The first stage addressed the control group and was held 3 hours per week for 5 weeks; the teaching method was teacher-oriented for 1.5 hours of traditional teaching and 1.5 hours of peer discussion. The course highlighted professions related to advertising design, including marketing, communication, technology, and design thinking, as well as advertising cases and

design productions. During the fifth week, the groups proposed advertising designs, and their presentations were evaluated by experts, who offered suggestions. In addition, each student completed a design thinking test. The second stage addressed the treatment group (i.e., the experimental group) and was also held for 5 weeks; the teaching method was participant-oriented with instructor guidance on design thinking, covering activities such as field research, empathy mapping, customer journey mapping, and brainstorming meetings on consumer needs, ideas, and prototype design and testing. During the final week, the participants presented advertising designs by group, followed by suggestions and evaluations by experts. Each student similarly took a design thinking test.

Operational Definitions of Variables and Questionnaire Design

Below are the operational definitions of the five mediator variables of this study:
(1) Empathy: guiding students to observe consumers, participate in branding issues through field research, and create empathy maps, personas, and customer journey maps.
(2) Define: redefining the problem according to the messages collected in the "empathy" phase and determining the real needs of the user, then defining then with a short phrase.
(3) Ideate: team brainstorming through an "ideate" process based on the principle of "three don'ts and five dos," that is, "don't interrupt, don't criticize, and don't digress; do extend others' ideas, draw pictures, be crazy, produce numerous ideas, and write titles," to trigger ideas and finally determine the most suitable solution.
(4) Prototype: guiding students to evolve and embody their ideas by focusing on target consumers, making drafts, and discussing and completing prototypes before optimization.
(5) Test: actually placing the prototype work on the market, understanding the feasibility of the prototype through experience, and determining the direction of optimization.

The questionnaire contained a revision of the scale for design thinking-based learning proposed by Tu, Liu, and Wu (2018), with seven items on "empathy," seven on "define," seven on "ideate," seven on "prototype," six on "test," and four on the teaching approach overall, totaling thirty-eight items. A 5-point Likert-type scale was adopted.

Results and Discussion

Sample Characteristics; Reliability and Validity Analysis

In all, 48 students participated in the study: 41 (85.4%) and 7 (14.6%) were women and men, respectively. Regarding the departments to which the participants belonged, 39 were in the commercial design department (81.3%). In terms of education and training, 46 (95.8%) and 2 (4.2%) were and were not trained in design, respectively. A confirmatory factor analysis (CFA) was conducted using Mplus 8.1 to test the reliability and validity of the latent variables, namely "empathy" (6 items), "define" (7 items), "ideate" (7 items), "prototype" (7 items), and "test" (7 items). The results indicated that the sample data and the measurement model fitted well and exhibited good convergent validity; the Cronbach's α of the correlation matrix and internal consistency index of the latent variables were as follows: "empathy" = 0.84, "define" = 0.79, "ideate" = 0.87, "prototype" = 0.83, and "test" = 0.81. The combined reliability of the variables were as follows: "empathy" = 0.84, "define" = 0.78, "ideate" = 0.87, "prototype" = 0.82, and "test" = 0.81 (Table 1). The results indicated high internal consistency between the measurement items. Positive correlations were observed among all the relevant coefficients of the variables, and the confidence intervals of all correlation coefficients did not include 1. On

the whole, the data measured for the study had the reliability and validity required for hypothesis verification.

Table 1: Correlation Matrix and Internal Consistency Indicators

		M	*SD*	1	2	3	4	5
1.	empathy	3.84	0.53	***0.84***				
2.	define	3.8	0.55	0.92***	***0.79***			
3.	ideate	3.56	0.61	0.62***	0.71***	***0.87***		
4.	prototype	3.81	0.48	0.60***	0.75***	0.68***	***0.83***	
5.	test	3.75	0.59	0.49***	0.65***	0.57***	0.57***	***0.81***
	CR			0.84	0.78	0.87	0.82	0.81
	AVE			0.47	0.42	0.57	0.44	0.46

***p<0.001. Note: The diagonal value of the correlation matrix is the Cronbach's α value of each measurement variable.

Manipulation Check on the Treatment and Control Groups

A manipulation check was conducted through applying different teaching modes to the treatment group and the control group. To guarantee consistency between participant perception and the experimental manipulation design, participant thoughts were measured using four items ("On the whole, I have applied design thinking in this project to understand consumer needs"; "On the whole, I have applied design thinking in this project to develop design concepts"; "On the whole, I have applied design thinking in this project to enter the design context more smoothly"; and "On the whole, I have applied design thinking in this project to enhance my design performance"). An assessment was conducted using Likert's 5-point scale; higher scores meant greater perception of design thinking-based teaching. The results indicated that after the treatment group experienced the design thinking-based teaching mode, their average score was significantly higher than that of the control group (did not experience design thinking-based teaching; $M_{\text{treatment group}} = 4.14$ vs. $M_{\text{control group}} = 3.41$, $t = 6.13$, $p < 0.001$). Thus, the manipulation of the treatment and control groups was successful. In addition, to exclude the effect of other variables, a potential covariate test on individual difference variables that might affect learning achievement (i.e., sex and department) was conducted. The results indicated that neither gender ($F = 2.85$, $p = 0.10$) nor department ($F = 2.45$, $p = 0.09$) had a significant effect on learning achievement; the two covariates were thus excluded from the subsequent analysis.

Research Hypothesis Verification

Analysis of variance (ANOVA) was performed to verify H1 and test the influence on learning achievement in the treatment and control groups. The results indicated a significant main effect (F (1,94) = 46.29, $p < 0.001$) (Table 2) on the treatment group. Additional analysis indicated that after the treatment group adopted the teaching mode based on design thinking methods, they achieved higher learning achievement than did the control group ($M_{\text{treatment group}} = 86.10$ vs. $M_{\text{control group}} = 74.29$). Thus, H1 ("Design thinking-based teaching positively affects learning achievement") was supported.

Table 2: Variance Analysis Results

Variables Sources	*SS*	*df*	*MS*	*F*	*Sig.*
ECM	3348.84	1	3348.84	46.29***	0.00
Intercept	617443.76	1	617443.76	8534.76***	0.00
Design Thinking Teaching	3348.84	1	3348.84	46.29***	0.00
Error	6800.40	94	72.34		
Total	627593.00	96			
Corrected Total	10149.24	95			

Note: 1.***p<0.001; 2. R^2=0.33

To verify whether satisfaction with design thinking was a mediating mechanism in design thinking-teaching affecting learning achievement, the mediating effect test techniques of Baron and Kenny (1986) as well as Hayes (2013) were referred to in order to determine whether H2 through H6 were mediators. First, coefficient "a" was the effect of the independent variable (design thinking-based teaching) in influencing the mediator variables ("empathy," "define," "ideate ," "prototype," and "test"). Coefficient "b" was the effect of mediator variables influencing the dependent variable (i.e., learning achievement). Coefficient "c" was the effect of the independent variable in influencing the dependent variable (i.e., direct effect); Coefficient "c'" was the effect of the independent variable in influencing the dependent variable after the mediator variables were controlled. According to Baron and Kenny (1986), four conditions are required for the existence of a mediating effect: (1) an independent variable can predict the dependent variable ("c" must be significant); (2) the independent variable can predict the mediator variable ("a" must be significant); (3) the mediator variable can predict the dependent variable ("b" must be significant); and (4) when both the independent variable and the mediator variable can predict the dependent variable, the effect of the initial independent variable in influencing the dependent variable must decrease or be nonsignificant (c' < c or c' was nonsignificant).

The test on the mediating effect of "empathy" revealed positive significant correlation between the treatment group and learning achievement ($\beta = 11.81$, $t = 6.80$, $p < 0.001$; "c" was significant), and the effect on "empathy" was positive and significant ($\beta = 0.39$, $t = 3.82$, $p < 0.001$; "a" was significant). When the learning achievement of the treatment group was predicted by design thinking-based teaching and "empathy" simultaneously, "empathy" positively and significantly affected learning achievement ($\beta = 3.14$, $t = 2.09$, $p < 0.05$; "b" was significant), and the effect of design thinking-based teaching in influencing learning achievement was significant ($\beta = 11.88$, $t = 6.33$, $p < 0.001$) but greater than the initial effect (c' > c). PROCESS v3.5 by Hayes (2013; Model 4) was adopted to calculate the mediating effect. A test using bootstrapping on 5,000 samples revealed that the coefficient "ab" (i.e., mediating effect) was −0.07, and the confidence interval at the 95% confidence level ranged from −1.38 to 0.88 and included 0, indicating that "empathy" had no mediating effect. Thus, H2 was not supported; "empathy" did not mediate the effect of design thinking-based teaching in influencing learning achievement (Figure 3).

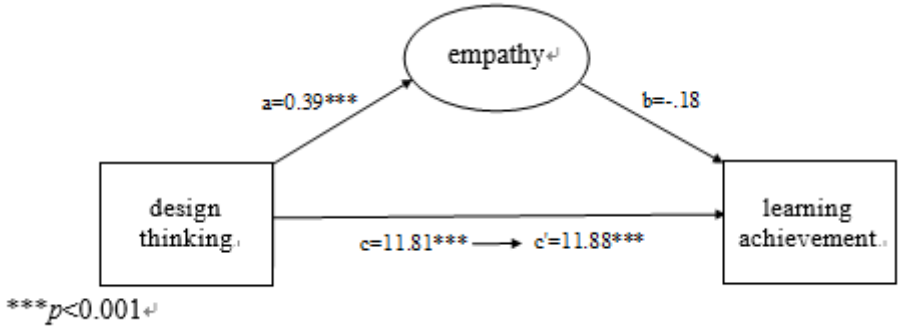

Figure 3: The Mediation Model with Empathy as Mediation Variable

The test on the mediating effect of "define" revealed that design thinking-based teaching was positively and significantly correlated with learning achievement ($\beta = 11.81$, $t = 6.80$, $p < 0.001$; "c" was significant), and the effect on "define" was positive and significant ($\beta = 0.41$, $t = 3.95$, $p < 0.001$; "a" was significant). When learning achievement was predicted by design thinking-based teaching and "define," the latter positively affected learning achievement, but the effect was not statistically significant ($\beta = 0.47$, $t = 0.27$, $p = 0.79$; "b" was insignificant); the effect of design thinking-based teaching in influencing learning achievement was significant ($\beta = 11.62$, $t = 6.17$, $p < 0.001$) but inferior to the initial effect (c' < c). A test using bootstrapping revealed that the coefficient "ab" (i.e., mediating effect) was 0.19, and the confidence interval at the 95% confidence level ranged from −1.28 to 1.30 and included 0, meaning that "define" had no mediating effect. Thus, H3 was not supported, and "define" did not mediate the effect of design thinking-based teaching influencing learning achievement (Figure 4).

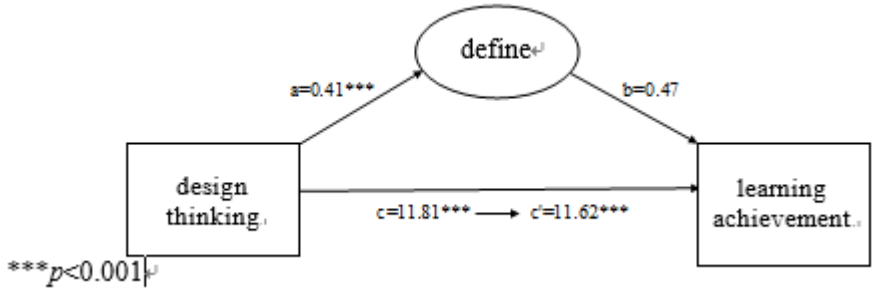

Figure 4: The Mediation Model with Define as the Mediation Variable

The test on the mediating effect of "ideate" revealed that design thinking-based teaching was positively and significantly correlated with learning achievement ($\beta = 11.81$, $t = 6.80$, $p < 0.001$; "c" was significant), and the effect on "ideate" was positive and significant ($\beta = 0.39$, $t = 3.34$, $p < 0.001$; "a" was significant). When learning achievement was predicted by design thinking-based teaching and "ideate," the latter positively affected learning achievement, but the effect was not statistically significant ($\beta = 3.14$, $t = 2.09$, $p < 0.05$; "b" was insignificant); the effect of design thinking-based teaching in influencing learning achievement was significant ($\beta = 10.58$, $t = 5.87$, $p < 0.001$) but inferior to the initial effect (c' < c). A test using bootstrapping revealed that the coefficient "ab" (i.e., mediating effect) was 1.23, and the confidence interval at the 95% confidence level ranged from −0.40 to 2.15and not included 0, meaning that "define" had no mediating effect. Thus, H4 was supported, and "ideate" did mediate the effect of design thinking-based teaching influencing learning achievement (Figure 5).

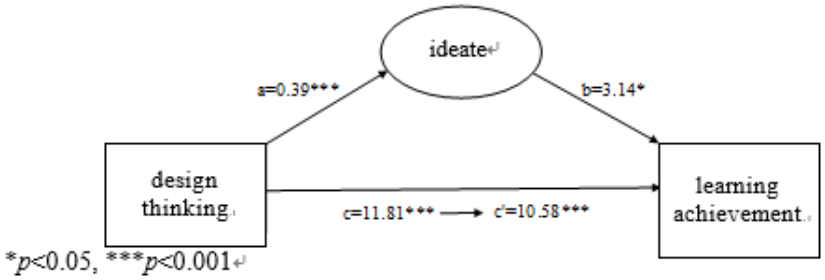

Figure 5: The Mediation Model with Ideate as the Mediation Variable

The test on the mediating effect of "prototype" revealed that design thinking-based teaching was positively and significantly correlated with learning achievement ($\beta = 11.81$, $t = 6.80$, $p < 0.001$; "c" was significant), and the effect on "prototype" was positive and significant (β=0.31, t=3.25, p<0.001; "a" was significant). When learning achievement was predicted by design thinking-based teaching and "prototype," the latter positively affected learning achievement, but the effect was not statistically significant (β=1.38, t=0.72, p=0.47; "b" was insignificant); the effect of design thinking-based teaching in influencing learning achievement was significant (β=11.39, t=6.20, p<0.001) but inferior to the initial effect (c' < c). A test using bootstrapping revealed that the coefficient "ab" (i.e., mediating effect) was 0.42, and the confidence interval at the 95% confidence level ranged from -0.73 to 1.71and included 0, meaning that "prototype" had no mediating effect. Thus, H5 was not supported; "prototype" did not mediate the effect of design thinking-based teaching in influencing learning achievement (Figure 6).

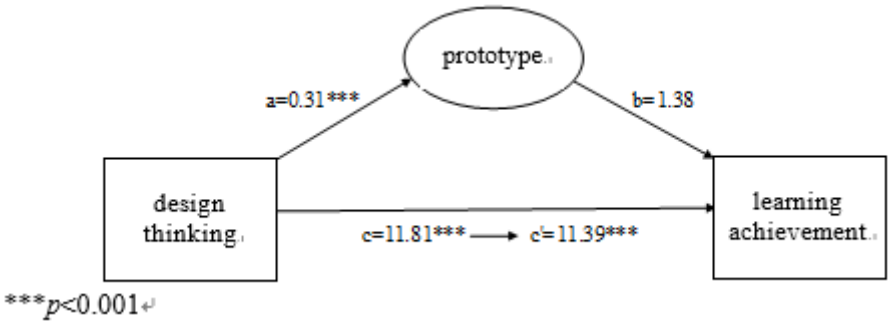

Figure 6: The Mediation Model with Prototype as the Mediation Variable

The test on the mediating effect of "test" revealed that design thinking-based teaching was positively and significantly correlated with learning achievement ($\beta = 11.81$, $t = 6.80$, $p < 0.001$; "c" was significant), and the effect on "test" was positive and significant (β=0.34, t=2.97, p<0.01; "a" was significant). When learning achievement was predicted by design thinking-based teaching and "test," the latter positively affected learning achievement, but the effect was not statistically significant (β=6.37, t=4.48, p<0.001; "b" was insignifican; the effect of design thinking-based teaching in influencing learning achievement was significant (β=9.63, t=4.48, p<0.001) but inferior to the initial effect (c' < c). A test using bootstrapping revealed that the coefficient "ab" (i.e., mediating effect) was 2.18, and the confidence interval at the 95% confidence level ranged from 0.42 to 4.87and not included 0, meaning that "test" had no mediating effect. Thus, H6 was supported; "test" did mediate the effect of design thinking-based teaching in influencing learning achievement (Figure 7).

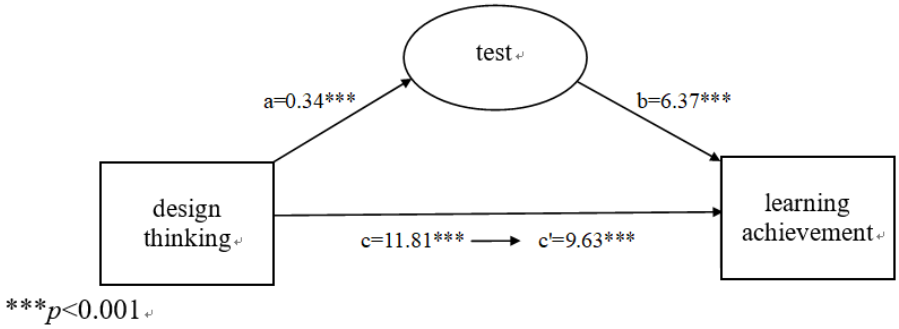

Figure 7: The Mediation Model with Test as the Mediation Variable

Conclusions

Advertising is a profession with complex forms and numerous aspects of communication. In design education, instructors should reflect on suitable teaching methods for advertising design. In this study, two teaching modes were used with the student participants. The control group received traditional teaching based on lectures delivering design knowledge and skills. The treatment group adopted the innovative method of design thinking advocated by Stanford University; through the student-oriented method, the students were guided to explore issues including "empathy," "define," "ideate," "prototype," and "test." As the findings proved, compared with the traditional teaching method, operating the methods of design thinking in class both enhanced student participation in advertising issues and facilitated interaction and effective communication between team members as well as instructors and students, finally yielding a positive effect on learning achievement.

Contemporary changes have led to the emergence of innovative advertising media. Moreover, diverse forms for expressing advertising creativity have been extended through combinations of new technologies such as artificial intelligence, augmented reality (AR), and virtual reality, thus providing various storytelling forms and experiences for brands. This study addressed five variables in design thinking ("empathy," "define," "ideate," "prototype," and "test") and explored their mediating effects on design thinking-based teaching. The findings indicated that two variables in design thinking, namely "ideate" and "test," had a mediating effect on enhancing learning achievement regarding AR advertising design. Deriving more interactive creativities by integrating technologies into advertising design has become a trend. The employment of AR will not completely replace two-dimensional advertising modalities. Rather, through experience, AR yields a multiplying effect for the original presentation of media. Through AR creativity, rigid two-dimensional advertisements become more topical and interesting. Therefore, in conducting AR advertising design, instructors are suggested to use design thinking tools such as empathy maps, personas, and customer journey maps to guide students to penetrate the technology acceptance modes of consumers and users, and participate in technology-based contexts for inspiration. Finally, designs were completed through prototyping to test the pros and cons of the design results, followed by optimization and improvement. In design thinking, the learning objective is to make every student an innovator. In the AR advertising design process in this study, the students were trained to depart from traditional analytic thinking and exert innovative analytic thinking to make advertising design course material more interesting, which further enhanced learning achievement. The results of the study serve as a pedagogical reference for instructors in the design profession.

Acknowledgements

This study was sponsored by Taiwan's Ministry of Science and Technology (MOST) under the research project no. MOST 109-2410-H-130-004 and Taiwan's Ministry of Education (MOE) Teaching Practice Research Program under the research project no. PHA1090371. We hereby express our gratitude.

References

Baron, R. M. & Kenny, D. A. (1986). The moderator-mediator variable distinction in social psychological research: Conceptual, strategic, and statistical considerations. *Journal of Personality and Social Psychology, 51(6),* 1173-1182. DOI: 10.1037//0022-3514.51.6.1173.

Bauer,R. M. & Eagen, W. M. (2008). Design Thinking-Epistemic Plurality in Management and Organization. *Aesthesis, 2(3),* 64-74.

Burke, R. R., Rangaswamy, A., Wind, J., & Eliashberg, J. (1990). A knowledge-based system for advertising design. *Marketing Science, 9(3),* 212–229.

Chao, H. L. & Kao, C. F. (2017). The Analysis on Popular and Forward-Looking Research Issues in Visual Arts Education from 2006 to 2016, *Research in Arts Education*, *33*, 1-31.

Cheung, M. (2011). Creativity in advertising design education: an experimental study. *Instructional Science*, *39(6),* 843-864.

Dornbusch, S., Ritter, P. L., Leiderman, P. H., Roberts, D. F., & Fraleigh, M. J. (1987). The relation of parenting style to adolescent school performance. *Child Development, 58(5),* 1244-1257; DOI: 10.2307/1130618

Dunne, D. & Martin, R. (2006). Design Thinking and How It Will Change Management Education: An Interview and Discussion. *Academy of Management Learning & Education, 5*, 512–523.

Gong J. R. (2017, November 30). Joining AI marketing ads will become personalized. *Chinatimes.com*. Retrieved from http://www.chinatimes.com/print/newspapers/20171130000840-260301

Gong, S. Z. (2013). Philosophical thinking in design education-find the reason for "intervention" and "existence". *Journal of the Architectural Society of Taiwan,* 44-49.

Griffin, W. G. (2008). From performance to mastery: Developmental models of the creative process. *Journal of Advertising, 37(4),* 95-108.

Habib, S. (2015). Teaching Approaches in Advertising: Creativity and Technology. *Journal of Advertising Education,* 17-25; DOI: 10.1177/109804821501900104

Hawryszkiewycz, I. (2013). *Design Thinking for Business: A Handbook for Design Thinking in Wicked Systems.* Fremantle (Australia): Vivid Publishing.

Hayes, A. F. (2013). Introduction to Mediation, Moderation, and Conditional Process Analysis: A Regression-Based Approach. New York, NY: The Guilford Press

Johnson, P. M., & Jones, S. K. (2010). Beyond the banner: Teaching powerful creative techniques in digital marketing. *Journal of Advertising Education, 14(1),* 7-14.

Mellesa, G., Howard, Z., Thompson-Whiteside, S. (2012). Teaching Design Thinking: Expanding Horizons in Design Education. *Social and Behavioral Sciences, 31*, 162-166. DOI: 10.1016/j.sbspro.2011.12.035

Plattner, H. (2010). An Introduction to Design Thinking Process Guide. *The Institute of Design at Stanford*. Retrieved from: https://dschool-old.stanford.edu/sandbox/groups/designresources/wiki/36873/attachments/74b3d/ModeGuideBOOTCAMP2010L.pdf

Porter, M. & Heppelmann, J., (2017). Why Every Organization Needs an Augmented Reality Strategy, *Harvard Business review*, November–December.

Razzouk, R. & Shute, V. J. (2011). What Is Design Thinking and Why Is It Important? *Review of Educational Research, 82*(3), 330-348; DOI: 10.3102/0034654312457429

Registration Section of Academic Affairs Office (2019). Grade system. *National Taiwan Normal University*. Retrieved from: http://iweb.ntnu.edu.tw/aa/gpaweb/content.html

Rowe, P. (1987). *Design Thinking*. The MIT Press, Cambridge.

Tu, J. C., Liu, L. X., Wu, K. Y. (2018). Study on the Learning Effectiveness of Stanford Design Thinking in Integrated Design Education. *Sustainability*, *10(8),* 2649; DOI: 10.3390/su10082649.

Wiliam, D. (2007). *Keeping learning on track: Classroom assessment and regulation of learning*. In F. K. Lester Jr. (Ed.), Second handbook of research on mathematics teaching and learning: A project of the National Council of Teachers of Mathematics (1053-1098). Charlotte, NC: Information Age Publishing.

Yang, C.M. 1 & Hsu, T.-F. (2020). Integrating Design Thinking into a Packaging Design Course to Improve Students' Creative Self-Efficacy and Flow Experience. *Sustainability*, *12(15),* 5929; DOI: 10.3390/su12155929

Yu M. N. (2006). Discussion on factors affecting learning achievement. *Bimonthly Publication of Educational Materials and Research*, *73,* 11-24.

Zhu, J. X. (2017). The trend of college advertising design teaching reform in the new media era. *News lover*. Retrieved from: http://media.people.com.cn/n1/2017/1227/c416017-29731952.html

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