

The Impact of Instructors' Capacity on Technology Integrated Education in Interior Design Studios^{**}

스튜디오 수업에서 교사의 역량이 기술통합교육에 미치는 영향

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Abstract 현재 기술과 정보통신의 발전은 학생들의 학습과정에 커다란 변화를 가져왔다. 그러나 현재까지의 연구들은 주로 수업에 활용 가능한 기술개발에 치중되어 있었으며, 교사들이 수업을 위해 활용하게 되는 다양한 기술과 교수법에 대한 연구는 부족한 실정이다. 따라서 본 연구에서는 수업을 진행하고 있는 교사들을 대상으로 교사의 기술사용과 가치, 기술 숙련도를 이해하고 이것이 학생들의 기술통합교육에 어떠한 영향을 주고 있는지를 파악하고자 하였다. 연구자는 특히 디자인툴들이 빈번히 사용되는 디자인 교육에 있어서의 선생님의 기술통합교육의 중요성을 조사하고자 하였다. 연구방법으로는 디자인 툴을 이용하여 스튜디오 수업을 진행하고 있는 국내 7개 대학의 스튜디오 수업 담당 교사들을 대상으로 3주에 걸쳐 설문과 면접을 실시하였다. 추가적으로 조사 대상 교사의 수업을 듣는 학생들을 대상으로 교수법에 대한 설문을 병행하였다. 스튜디오 수업의 디자인 과정에서 학생들이 기술툴들을 다양하게 활용하기 위해서는 교사의 학습법이 매우 중요한 요소였으며, 교사들이 디자인툴의 사용에 익숙하고 그것의 활용도를 폭넓게 이해하고 있을 때 학생들의 기술통합수업이 가능하였다.

Keywords 기술 통합 교육, 교수법, 학습법, 디자인 툴, 스튜디오
Technology Integrated Education, Teaching Method, Student Learning, Design Tool, Studio

1. Introduction

On a global scale, many governments have significantly invested in providing schools with more digital technology resources. Students who were born into the digital era are more technologically capable, so they generally expect that schools would provide technology integrated education, acknowledging their capability with technologies. Despite the governments' investment in digital resources in schools and the students' expectations, empirical research demonstrates that the current education systems do not reflect proper utilization of the technological resources and the students' expectations.¹⁾

Current technological developments may have a positive effect on students' learning processes, so

teachers should be willing to utilize innovative strategies, methodologies, and approaches to instruction in using technologies for their lessons. For example, design exploration using digital tools becomes an integral part of the overall design process in studios, which augments students' ability to try more variations and access more sources of inspiration. Some researchers have investigated personal characteristics of innovative teachers and identified the attributes of their teaching methods because they believe that teachers should influence technology-integrated learning in the classroom.²⁾

This research started from the question of how students' learning processes will be influenced by instructors' instructional integration of technology in the classroom. It is expected that instructors' views on

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1) OECD, Inspired by technology, driven by pedagogy, OECD, 2010, pp.1-3

2) Simplicio, Joseph S. C., Teaching classroom educators how to be more effective and creative teachers, Education, 120, 2000, pp. 675-680

technology-integrated learning may affect students' learning processes, by encouraging or discouraging their use of the technology in the design process. Rather than the technological developments themselves, such as new software and computer skills, this research emphasizes how instructors integrate the technologies into their courses with a specific perspective, and how students utilize technologies for their learning accordingly.

2. Related studies on technology integration

Widespread technology use in society is moving schools toward more innovative applications of technology in curriculum.³⁾ The application of technologies are reshaping how students access education information, communicate, and learn within classrooms.⁴⁾ Technologies support more innovative forms of teaching and learning, thus schools need capitalize on students' natural inclinations as learners. Technology-enhanced learning can help students develop their competencies, such as thinking and problem solving, interpersonal and self-directional skills, and digital literacy.⁵⁾

Most studies on educational technology have focused on quantifying the numbers of computers or Internet access in classrooms. Recently, some researchers started to analyze the process of technology integration and to measure how teachers used technology in the classroom.⁶⁾ For the technology integration in education, teachers need effective professional development, and high quality of professional development provide more comprehensive learning experiences.^{7,8)} Leadership development is also

crucial to teachers because they play an important role in successful implementation of technology.⁹⁾

As mentioned above, technology integrated education has been emphasized as one of novel methods, further, researched in the education area. However, most studies on architectural design education associated with technologies are centered on computer-aided design or distant learning.^{10,11)} Some studies have mainly focused on the utilization of digital tools for designs, not paying much attention to the impact of instructors' technology capabilities and education methods on students' learning. This research starts from this gap to contribute the design domain and education.

There are two representative studies which propose several stages for the technology integrated education. The the Apple Classroom of Tomorrow (ACOT) project¹²⁾ served as a foundation for research related to using technology as an integral part of teaching and learning. The ACOT project produced an adoption model, the Stages of Instructional Evolution, for the use of technology in the classroom. According to the model, educators go through five stages of thought and practice when adopting technology: Entry-Learn, the basics of using technology. Adoption-Use, new technology to support traditional instruction. Adaptation-Integrate, new technology into traditional classroom practice. Appropriation-Focus, on cooperative, project-based, and interdisciplinary work, incorporating the technology as needed and as one of many tools. Invention-Discover, new uses for technology tools.¹³⁾ In 2000, the Consortium on Chicago School Research¹⁴⁾ investigated teachers'

educational research, 38, 2001, pp.915 - 945

3) Dede, C., Reinventing the role of information and communications technologies in education, In L. Smolin, K. Lawless, & N. C. Burbules (Eds.), Information and communication technologies: Considerations of current practice for teachers and teacher educators, Blackwell, 2007, pp.11 - 38
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 12) Sandholtz, J., Ringstaff, C., & Dwyer, D., Teaching with technology: Creating student-centered classrooms, Teachers College Press, 1997
 13) Apple Computer, Inc., Changing the conversation about teaching, learning, and technology: A report on 10 years of ACOT research, Apple Computer, Inc., 1995. pp.22-25

assignment of technology-related lessons and projects. Based on the responses from the teachers, they categorized teachers' levels of technology integration as follows: highly integrated, integrated, modestly integrated, limited integration, no integration. The results of the study show teachers' existing views and practices on technology integration.

By utilizing the teachers' levels of technology integration, this research investigated the level of instructors' technology use and value of technology, and find how much these factors affect instructors' technology integrated education. Especially, it is to present the importance of instructors' awareness of the technology integrated education in teaching design where the design tools are frequently used.

3. Method

This research is to investigate how instructors' capabilities influence on the technology integrated education in design studios. We chose interior design majors in Universities located in Seoul. They utilize design tools such as AutoCAD, SketchUP, Revit and Max. We asked thirteen Universities if we could conduct questionnaire survey and obtained the permission from seven Universities. We performed the questionnaire survey with two or three instructors in each University, further, students in their studio classes.

Eighteen instructors who lecture the studio classes were surveyed and interviewed. Mostly questionnaires were used, and interviews were additionally carried out on several items that required much detailed instructors' opinions and thoughts. In addition, thirty students who attend those instructors' classes were randomly sampled for a comparative study between instructors and students about creative pedagogics. The studios were four-year courses, thus the subjects were four year students consisting of ten male and twenty female students. The data was collected over the period of three weeks and analysed by SPSS 20 statistic program. By using analysis of variance and regression analysis, we scrutinized the relation

between instructors' value of technology and the class, and analyzed what the main factors that influence instructors' value of technology are.

4. Results

We investigated the extent to which instructors are using technology in their classes and how much they encourage students to use such technology. We analyzed how instructors utilize computers with the Internet access for classroom instruction to some extent and address how much students utilize technologies such as computers and CAD programs for design communication, presentation, drawing, and rendering in studio courses.

4.1. Instructors' Use and Value of Technology for Education

(1) Instructors' Characteristics

The instructors' characteristics such as ages, gender, lecture experience, design studio lecture and practice experience were investigated as shown in Table 1.

<Table 1> Instructors' Characteristics n=18

Characteristics		Frequency(%)	Mean
age	35 - less than 40 years old	2	41.66
	40 - less than 45 years old	10	
	45 - less than 50 years old	6	
gender	male	6	-
	female	12	
lecture	1 - less than 5 years	6	7.00
	5 - less than 10 years	6	
	10 - less than 15 years	6	
design studio	1- less than 5 years	8	4.66
	5 - less than 10 years	10	
practice	1 - less than 5 years	6	9.55
	5 - less than 10 years	4	
	more than 10 years	8	

The instructors' average age is 41.66 years old and female instructors are more than male instructors. The average lecture experience is 7 years, however, the experience of design studio education is only 4.66 years. Most instructors have much practice experience, averagely about 9.55 years. Two instructors have practice experience more than 20 years. This result shows that people who have much lecture and practice experience become instructors in design studios.

(2) Instructors' Technology Use

In order to identify the level of instructors' technology use, its use outside of a class was investigated.

14) Hart, H. M, Allensworth, E., Lauen, D. L., & Gladden, R. M., Educational technology: Availability and use in Chicago's public schools, Chicago: Consortium on Chicago School Research, 2002, pp.4-10

instructors were asked to answer how often they use SNS, email, skype, and how often they play games, listen to music, watch videos online and take pictures on their computers or cellphones by marking 1 point: do not use it at all, 2 points: use it 5-10 times a year, 3 points: use it 2-3 times a month, 4 points: use it 1-3 times a week, 5 points: use it every day.

<Table 2> Instructors' Technology Use

Technology use		Mean	SD
via computer	SNS	2.88	1.83
	e-mail	4.88	0.33
	skype	1.33	0.50
	playing games	1.22	0.44
	listening to music	3.55	1.74
via cellphone	SNS	4.66	1.00
	e-mail	4.44	1.33
	playing games	2.11	1.26
	listening to music	3.11	1.83
	watching TV programs, movies	2.44	1.01
via class	taking pictures	4.00	0.50
	portable computers	4.55	0.52
	projectors	4.77	0.44
	students' desktop computers	4.00	1.41
	group chat room related to a class	2.77	1.56
	e-class on the school's portal	4.33	1.11

As shown in Table 2. they used cellphones more often than computers, especially, for e-mails and SNS. We also investigated about the technology utilization of the classes by the same of the above marking method. A diverse range of digital devices were used at school including laptops, digital projectors (connected to laptops and handheld computers), desktop computers, notebook and tablet PC including iPad touches and tabs. it shows that the use of laptops (4.55) are more than that of desktops (4.0), especially, for e-class (4.33).

(3) Technology Proficiency

The level of instructors' technology proficiency was measured based on an assumption that their technology skills might affect teaching and learning in a class. As shown in Table 3, instructors' ability on the specific programs i.e. Photoshop, AutoCAD, SketchUP, Revit, Max etc. which are utilized in the studio classes was measured by marking 1 point: cannot use it at all, 2 points: can use the basic functions, but not utilize for a real project, 3 points: not proficient, but utilize for a real project, 4 points: proficient in using it for a real project. The result shows that all instructors are capable of using Powerpoint (4.0) and Autocad (4.0) while they are not proficient in using 3D modeling tools such as Max (2.22) and Revit (2.00).

In addition, instructors' technology use level was measured according to five levels of the model proposed the Apple Classroom of Tomorrow (ACOT) project. It proposed that educators go through five stages of thought and practice when adopting technology as mentioned in section 2. As shown in Table 3, it indicates that 55.6% of them are at the adaptation level.

<Table 3> Instructors' Technology Proficiency n=18

Technology proficiency	Mean	SD
Powerpoint	4.00	0.00
Photoshop	3.77	0.44
AutoCAD	4.00	0.00
SketchUp	3.55	0.72
Revit	2.00	1.22
Max	2.22	1.39
Technology use level	Frequency	Percent(%)
Entry	0	0
Adoption	0	0
Adaptation	10	55.6
Appropriation	6	33.3
Invention	2	11.1

(4) Instructors' Value of Technology

Instructors' value of technology for education was examined with the scale 1 (not at all agree) to 5 (strongly agree). The mean value of all questions is above 4.00 (agree), which suggests that instructors consider value of technology for education significantly. In particular, regarding the question 'there is a difference in the use of technology tools or the level of utilizing them according to instructor's teaching method', the result shows that instructors are aware that their own teaching methods influence on students' utilization of the technology tools significantly (4.88).

<Table 4> Instructors' Value of Technology for Learning

instructors' value of technology for learning	Mean (SD)
instructor's technology proficiency level affects the class.	4.11 (1.05)
It is important for students to learn and familiarize with technology tools.	4.55 (0.72)
Utilizing technology tools for students in classes supports the level of motivation, participation, and interest.	4.33 (1.00)
Utilizing technology enables for instructors to provide customized learning for students rather than instructors' one way tutoring.	4.11 (0.78)
The utilizing methods should be provided in the studio classes by integrating the contents that are taught in the existing technology tool classes.	4.55 (0.52)
There is a difference in the use of technology tools or the level of utilizing them according to instructor's teaching method.	4.88 (0.33)
Technology empowers instructors to offer various teaching techniques and materials.	4.77 (0.66)

To investigate instructors' value of technology, the interview was conducted in addition to the questionnaire

survey. The question was that ‘Would you explain what technical education means to you?’ Majority of them replied that technology tools are the essential to the design communication for the development of design at the studio classes. They explained that technology tools are the means enabling effective representation of the produced work. Furthermore, several instructors emphasized that ‘technical education should be employed as a way to deploy designers’ ideas and display their creativity for self-expression on top of it being the simple communication method’. One instructor argued that practice for improving design thinking should be performed in studios based on the capability of technology tools while the proficiency for the technology tools itself should be trained in a separated class.

4.2. Technology Integrated Education

(1) The Use of Technology Tools in Class

In order to identify the level of technology being applied to instructors’ class, the frequency of technology tools’ use for assignments, the ratio of assignments using technology tools among the total assignments, and the level of utilizing technology tools in the class were measured as shown in Table 5. ‘One or two times a month’ (44.4%) is the most frequent one for technology tools’ use in assignments. However, 22.2% of them asked students to use technology tools for the assignment one or two times in two months, suggesting rather low frequency. In ratios of assignments using technology tools among the total assignments, it was reported that the category ‘10~40% of the total assignments’ is 33.3%, the category ‘40~60% of the total assignments’ is 44.4%’ and the category ‘above 60% of the total assignments’ is 22.2%. The results suggest that the ratio of assignments using technology tools among the total assignments is different according to instructors. 55.6% of them utilized the technology tools as design communication means for sketch, drawing, rendering, and presentation while 44.4% of them use the technology tools for solving design problem focusing on creative thinking.

We investigated if instructors allow students to access to the Internet during classes and found that majority of them (77.8%) encouraged students to use it while some instructors (22.2%) prohibited their

students from utilizing during classes. Most of instructors (88.9%) believed that the most influential factor is the adoption of the technology integrated education, not the instructors’ or students’ ability incorporating technology.

Additionally, instructors were interviewed to find out what the problems are in teaching students to use the technology tools in the class. The biggest problem is that students tend to misperceive being technically proficient means good design ability. Another issue was that students only focus on the ways to execute the tools as a mean to draw visual outcomes despite instructors’ intention for students to understand the principles of the technology tools and to apply them creatively in a design process. As a result, students produce a similar work rather than an innovative one even though they utilize technology tools.

<Table 5> Technology Integrated Education n=18

Frequency of technology tools’ usage for assignments	Frequency (%)
1-2 times every 2 months	4(22.2)
1-2 times a month	8(44.4)
Almost every week	6(33.3)
Ratio of assignments using technology tools among the total assignments	
10-40% of the total assignments	6(33.3)
40-60% of the total assignments	8(44.4)
above 60% of the total assignments	4(22.2)
Level of utilizing technology tools in the class	
internet search, sketch, presentation related assignments	10(55.6)
solving design problems of creative thinking related assignments	8(44.4)
Accessibility to the internet during the class	
prohibit it, but occasionally allow depending on the class	4(22.2)
prohibit it while explaining only, allow in most cases	4(22.2)
allow freely as long as it is related to the class	10(55.6)
The most important factor for technology integration	
instructors’ technology ability	0(0.0)
students’ technology ability	2(11.1)
instructors’ technology integrated class	16(88.9)

(2) Correlation

The correlation among three factors, instructors’ technology use, technology proficiency, instructors’ value of technology for learning, was tested through analysis of variance in order to see whether the level of instructors’ value of technology affects the technology integrated education that determines the level of technology assignments’ frequency, ratio, and

application etc. The frequency of the technology assignments only correlates to the level of instructors' value of technology as shown in Table 6.

The more instructors think that 'instructor's technology proficiency level affects the class.', 'Utilizing technology tools for students in classes supports the level of students' motivation, participation, and interest.', 'Utilizing technology enables for instructors to provide customized learning for students rather than instructors' one way tutoring.', 'There is a difference in the usage of technology tools or the level of utilizing them according to instructor's teaching method.', 'Technology empowers instructors to offer various teaching techniques and materials.', the more they allocate technology-related assignments to students.

<Table 6> Correlation Between Technology Assignments' Frequency and instructors' Value of Technology

assignment	low	medium	high	F(Prob)
	Mean			
instructor's technology proficiency level affects the class.	3.00	4.25	4.66	4.808* (0.024)
Utilizing technology tools for students in classes supports the level of motivation, participation, and interest.	3.00	4.50	5.00	12.500** (0.001)
Utilizing technology enables for instructors to provide customized learning for students rather than instructors' one way tutoring.	3.50	4.00	4.66	4.079* (0.038)
There is a difference in the usage of technology tools or the level of utilizing them according to instructor's teaching method.	4.50	5.00	5.00	5.833* (0.013)
Technology empowers instructors to offer various teaching techniques and materials.	4.00	5.00	5.00	5.833* (0.013)

Regression analysis was carried out to examine the extent how the level of instructors' technology use, technology proficiency and technology use affect their value of technology as shown in Table 7. The result shows that instructors' value of technology is influenced by their technology proficiency, technology use level, and technology use. F value of the regression statistics is 5.788 which is reasonable in p-value<0.01 and R-square (the percent of variance explained by the model) is 55.4%. instructors' technology proficiency influences their value of technology the most and instructors' technology use level also affects it, however technology use is not correlated with it.

<Table 7> Factors Affecting instructors' Value of Technology

	Coefficients	Standard Error	t statistic	Prob
intercept	3.246	1.129	2.875	0.012
technology proficiency	0.620	0.218	2.842	0.013
technology use level	0.365	0.158	2.316	0.036
technology use	-0.580	0.267	-2.169	0.051
R square = 0.554,		F = 5.788** (p<0.01)		

4.3. Innovative Teaching for Technology Integrated Education

(1) Innovative Teaching

The utilization level of instructors' creative pedagogics for the technology integrated education and how much it affects students' class were investigated. Instructors' evaluation on their pedagogics by using a Likert scale from the scale 1 'not at all agree' to 5 'strongly agree' and the result is shown in Table 8. Except the item of 'Encouraging students to choose digital environments and materials themselves and to use them in class (3.55)' and the item of 'using various evaluation methods for marking students' grades (3.88)', all items scored above 4.00. In particular, the result shows that instructors try to motivate student to do self-directed study in obtaining knowledge and encourage their new behavior.

<Table 8> Innovative Teaching

Teaching methods	instructor n=18	Student n=30
	Mean (SD)	
Employing various teaching resources such as images, books, and internet data	4.44 (0.72)	3.65 (1.03)
Encouraging students to understand the knowledge themselves	4.66 (0.50)	3.56 (0.80)
Connecting the knowledge or information to the current problems, issues or situations	4.44 (0.72)	3.68 (1.02)
Employing various teaching methods	4.00 (0.50)	3.25 (0.95)
Providing customized teaching to students' different learning styles	4.00 (0.70)	3.00 (1.07)
Encouraging students to try new behaviors	4.66 (0.50)	3.31 (0.96)
Using various evaluation methods for marking students' grades	3.88 (0.60)	3.15 (0.80)
Teaching contents and technologies that can be used in practice	4.22 (0.66)	3.03 (0.96)
Utilizing technology tools and materials for teaching	4.44 (0.52)	3.25 (0.95)
letting students use technology tools and materials provided by instructors	4.33 (0.50)	3.31 (0.85)
Encouraging students to choose technology tools and materials themselves and to use them in class	3.55 (0.72)	3.21 (0.96)

The survey results on instructors' evaluation of their own pedagogics and students' thoughts on instructors' pedagogics were compared. The compared answers of instructors and students on the same questions are presented in Table 8. There were differences between them as students' answers on all items scored lower than 4.00. Students were the most dissatisfied with the item of 'Providing customizing teaching to students' different learning styles (3.00)' and 'Teaching contents and technologies that can be used in practice (3.03)', which differs from what instructors consider the most discontented in their pedagogics. Thus, there was a gap between instructors' intentions and the level of students' experience on instructors' pedagogics for the technology integrated education.

(2) Correlation

Regression analysis was carried out to identify the most influential factor on instructors' creative pedagogics and the result is presented in Table 9. Regression statistics' F value is 6.896 (p-value<0.01) that is at an appropriate level, and R-square is 59%. The result indicates that instructors' value of technology affects the most on their creative pedagogics, and their lecture career or their practice experience do not influence on their creative pedagogics.

<Table 9> Factors Affecting Innovative Teaching

	Coefficients	Standard Error	t statistic	Prob
intercept	1.554	0.597	2.604	0.021
instructors' value of technology	0.579	0.130	4.452	0.001
lecture career	-0.11	0.022	-0.518	0.612
practice career	0.18	0.011	1.618	0.128
R square = 0.596,		F = 6.896** (p<0.01)		

5. Conclusion and Discussion

This research is to understand the meaning and rationale of technology integrated education in studio classes, by discussing the instructors' views on the adoption of technologies in design education. This research investigated instructors' perceptions of technology integrated education in design studios because various design tools are currently used in studios as one of the essential education methods.

This research suggests that instructors' teaching

method is the key element to utilize technology tools in various ways at the studio classes for students. Although instructors' technology use on a daily base does not affect the studio classes, their technology proficiency and level of technology use of design tools influence instructors' value of technology and their classes. Thus, the technology integrated class for students becomes possible when instructors are familiar with using the design tools and have a broad understanding of the tools' utilization.

Moreover, the level of technology utilization in the class varies depending on instructors despite almost all instructors acknowledge the importance of the technology tools for students to learn and the belief that utilizing the tools supports the level of students' motivation, participation, and interest. There are instructors who positively employ technology in the class recognizing the significance of technology education, whereas other instructors do not give technology assignments at a suitable level regardless of their awareness of it being essential. As shown in the interview, instructors do not sufficiently utilize the technology tools in the class even though they consider them as a creative thinking method for developing designers' ideas beyond them being a simple communication tool.

There was a discrepancy between instructors' evaluation on their creative pedagogics for technology integration and students' views to contents of instructors' class. instructors responded that they are utilizing creative pedagogics for technology integration, however students disagree with it. Therefore, developing new pedagogics by instructors might be possible through constant feedback from students. Furthermore, instructors' value of technology affects the most on their creative pedagogics, and their lecture career or their practice experience do not influence on their creative pedagogics. Therefore, instructors' professional development should focus on subject-specific content or specific teaching methods, further, instructors should receive follow-up support as they implement new skills in classrooms. Development of diverse learning methods and education that would enable these values of technology to be employed in the class is crucial.

There a limitation of the study in terms of the number of subjects because it is to target instructors who perform lectures in design studios and students

who join in the studios in Universities. The significance of this research is to emphasize the importance of the technology integrated design education. Although it is hard to generalize the result, this research found that instructors' capabilities of technologies influence students' learning in design studios. In future studies, systematic investigations including more subjects in different areas and curriculum will be done for the generalization.

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