Student Learning With Technology from an Instructional Economic Perspective: A Case Study

Pao-Nan Chou[1]

Introduction

Today, school teachers are expected (or required) to integrate information technologies into classroom instruction in an effort to exhibit the power of teaching innovation (Smith & Ragan, 2005) , especially at higher education settings. Under this learning trend, instructors tend to ignore the benefits of old technologies and embrace new technologies which are regarded as effective scaffolds to motivate students to engage learning process (Puntambekar & Hubscher, 2005). For example, several university faculty view the virtual reality like Second Life as a powerful tool which allows college students to discover new knowledge (The Horizon Report, 2007).

However, even though new technologies show a potential ability to enhance students' learning performances, old technologies often surpass new technologies from an instructional economic perspective. For instance, a number of studies have reported that old and new technologies can equally strengthen students' learning outcomes (e.g. Lin & Dwyer, 2004; Wang & Dwyer, 2003). Based on economic theories, adopting old technologies may be an economic approach while a comparison on learning outcomes between old and new technologies is the same. Therefore, is it necessary to invest extra expenditure on advanced technologies at classrooms?

The current study reports findings from two case studies conducted in Taiwan. Both two empirical cases evaluate the instructional benefits of old and new

[1] Dr. Pao-Nan Chou, Assistant Professor, Department of Education, National University of Tainan, Taiwan, pnchou@mail.nutn.edu.tw

technologies from an instructional economic perspective. The first case study compares the instructional use between inexpensive static graphic and expensive high-tech animation. In the second case study, a costless learning strategy and a costly gaming simulation are compared to explore the instructional effect on student learning.

Case Study 1: Static Graphic V.S. High-tech Animation

Technology Comparison

In the case study 1, two instructional technologies embedded in an electronic reading material were developed by one professional instructional designer. The first instructional technology called as old technology was designed by graphic software (PhotoShop). The budget invested in the technology development was about U.S. 80 dollars. In contrast, the other instructional technology called as new technology was designed by animation software (Flash). Investment in the animation development cost the researcher about U.S. 300 dollars.

Instructional Experiment

The case study 1 contained three treatments with the same reading material about science education:

1. Control group (Treatment 1): In this treatment, students only received an electronic reading material. No instructional technologies were provided.

2. Old technology group (Treatment 2): In this treatment, several static graphics, which relate to reading contents, were embedded in the electronic reading material.

3. New technology group (Treatment 3): In this treatment, several animations, which simulate some key concepts in reading contents, were embedded in the electronic reading material.

Research Participant

Sixty college students majoring in instructional technology from a Taiwan public university voluntarily participated in the case study 1. The average age of those student participants is 21 years old. During the implementation of the case study, participants were randomly assigned to one of three instructional treatments described earlier at one computer lab (each instructional treatment was scheduled at a specific

time slot). The distribution of participants was balanced across three treatment groups. In other words, the number of participants (n=20) in each treatment was the same.

Performance Measurement

At the computer lab, each participant was expected to read the electronic reading material presented in each personal computer in one-hour session. After completing assigned instructional treatments, students received a paper-based test, which measures what they learned during one-hour engagement in electronic reading. The performance measurement related to the reading material contains 60 multi-choice questions. A number of studies reported the measurement is extremely reliable (Chou & Hsiao, 2010a; Chou & Hsiao, 2010b).

Results

From the information presented in the Table 1, it appears that students in new technology group performed better than other groups. However, by using one inferential statistic technique (T-test), no significant difference was found between Treatment 2 and Treatment 3 ($p=0.74 > 0.05$). In other words, from an instructional statistic perspective, students' learning performances were the same between old and new technology groups.

Table 1 reports a descriptive statistics of different instructional treatments on the performance measurement.

Table 1 Test Result on Instructional Treatment (case study 1)

Instructional Treatment	Mean	Standard Deviation
Control Group	32.66	13.04
Old technology group	38.03	14.79
New technology group	41.54	11.50

Score in the test ranges from 0 to 60

Based on the results of the inferential statistic, compared to the control group, two instructional technologies developed in the case study 1 can equally support student learning (there was a significant difference between Treatment 2 & 1 and between

Treatment 3 &1). However, according to the rule of economic theories, investment in new technology is a money-losing proposition since the budget on the high-tech animation (US 300) is higher than the counterpart (static graphic, US 80). Without considering the students' learning motivation, as being a smart instructor, which instructional technologies should be adopted at classrooms?

Case Study 2: Learning Strategy V.S. Gaming Simulation

Technology Comparison

In the case study 2, only one instructional technology was developed by one professional instructional designer. This technology called as gaming simulation allows students to manipulate the learning contents in a virtual environment. The simulation was also designed by Flash software. The budget investment on the simulation technology was about US 600 dollars. In contrast, however, as for the learning strategy, no technology investment was involved. The learning strategy called as electronic reflection strategy aims to employ an existing technology (Microsoft word) to support student learning process.

Instructional Experiment

The case study 2 contains three instructional treatments with the same instructor. One unit lesson about the management of information technology was chose for the experiment. The details are:

1. Control group (Treatment 1): In this treatment, students received oral instruction from an experienced teacher. No specific instructional activity was implemented.

2. Old technology group (Treatment 2): In this treatment, after the instructor completed one unit lesson, students were asked to engage in a reflection activity, requiring learners to use Microsoft Word to reflect what they learned.

3. New technology group (Treatment 3): In this treatment, after finishing the unit lesson, students were asked to use a gaming simulation to review learning contents.

Research Participant

Sixty college students majoring in education from a Taiwan public university voluntarily participated in the case study 2. The average age of those student participants is 19 years old. During the implementation of the case study, participants

were randomly assigned to one of three instructional treatments described earlier at one computer lab (each instructional treatment was scheduled at a specific time slot). Each instructional treatment receives the equal number of participants (n=20).

Performance Measurement

At the computer lab, each participant was expected to listen to the instructor's 30-minute instruction on one selected unit lesson. Subsequently, students at each instructional treatment received different learning activities within 30 minutes. Immediately upon completion of one-hour their respective treatments, students received one reliable test developed by the instructor. This performance measurement consists of 20 multi-choice questions, which are related to the instructor's teaching contents.

Results

Table 2 reports a descriptive statistics of different instructional treatments on the performance measurement.

Table 2 Test Result on Instructional Treatment (case study 2)

Instructional Treatment	Mean	Standard Deviation
Control Group	72.50	11.31
Old technology group	82.25	11.04
New technology group	84.25	10.42

Score in the test ranges from 0 to 100

From the information presented in the Table 2, it appears that students in new technology group performed better than other groups. However, through transforming the raw data (Mean & Standard Deviation) into meaningful statistical number by T-test technique, no significant difference existed ($p=0.3>0.05$) between Treatment 2 and Treatment 3 (there was a significant difference between Treatment 2 & 1 and between Treatment 3 &1). In other words, students' learning performances were the same between old and new technology groups.

Compared to the control group, old and new technologies can equally enhance students' learning outcomes. However, an interesting point is that no expenditure of

Treatment 2 produced the same results as huge investment of Treatment 3's. Based on the rules of economic theories, is it wise to spend a considerable amount of money to develop a gaming simulation whose learning effect only gains 2-point mean difference (84.25 minus 82.25) and yields no significantly statistical difference?

Conclusion

In the modern society, human beings tend to use new high-tech gadgets simply because of technological trends. The same phenomenon occurs at learning environments where instructors often adopt new information technologies to pursue teaching innovation. However, school educators seldom evaluate the instructional economy of those new technologies. In the current study, two empirical case studies provided solid evidence, revealing that old and new technologies yield the same instructional benefits. From an instructional economic perspective, instructors may re-think the value of old technologies at classrooms without concerning about falling behind of technological trends.

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