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## Evaluation of the Effect of Educational Smartphone App for Nursing Students

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### Abstract

*The purpose of this study was to compare the effect of educational smartphone app with the effect of learning using conventional paper material. We developed an educational app for nursing students to learn how to read blood pressure and how to take a pulse. Evaluated was the effect of the app-based education by measuring the short term memory (right after the education), the long term memory (a week later) and the satisfaction. 25 college nursing students participated for the experiment group using the app-based education and 25 for the control group using paper-based education. We applied for statistical analysis Fisher's exact test and Independent t-test. The satisfaction of the app user's appeared significantly higher than that of the paper material user's ( $t=2.322$ ,  $p=0.024$ ). The short term memory score was 0.23 points higher in the experimental group (6.46 points) than in the control group (6.23 points), which was not statistically significant ( $t=0.422$ ,  $p=0.675$ ). Similar result came for the long term memory ( $t=1.006$ ,  $p=0.320$ ). After adjusting for the effect of a college grade using ANCOVA, the effect on memory was significantly higher in the experiment group. There might be differences in learning ability between the experimental and the control groups.*

**Keywords:** Software Convergence, Educational App, Nursing students.

## 1. Introduction

### 1.1 The Need for Research

Over the last ten years, smartphone usage has increased over the world and it has changed people's consumption patterns and lifestyles. We also use a variety of smartphone application (app) in educational field. From toy type educational app for infants to foreign language educational app for adults, the subjects and contents of educational app are expanding now [1].

App-based educational media can have high information accessibility and enhance the user's concentration on learning by using various contents. It is possible to present motion and movement effectively by using various types of media such as video, voice, and photo. Accordingly, the users can easily make participation in the process of education. Educational app is known to enhance the user's attention. For example, a study

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assessing the effectiveness of English vocabulary learning provided the learners who were bored with the traditional vocabulary learning method using printed written materials with an opportunity being educated through new media, smartphones and found that their recognition changed positively and their vocabulary learning ability also increased [2].

In recent years, many researchers have attempted to evaluate the effect of the application based education. Most of them focused on adult learners as research subject by measuring the satisfaction and preference about the application [1-3]. There have been few studies comparing college students' learning efficiency between application and written education methods. It is also difficult to find a researcher studying the effects in terms of either long-term memory or short-term memory [4]. We seek for evaluating the effect of smartphone app on education for nursing college students by measuring satisfaction level and the effect on the long-term memory and short-term memory.

## **1.2 Research Purpose**

The purpose of this study is to examine the influence of smartphone app on long-term memory, short-term memory, and learning satisfaction among nursing college students by comparing with the effect of conventional paper-written education material. The specific objectives of the study are as follows:

- 1) Compare long-term memory and short-term memory effect of education using smartphone application and education using existing paper material.
- 2) Compare the learning satisfaction of education using smartphone application and education using existing paper material.

## **1.3 Term Definition**

### 1) Long term memory

#### (1) Theoretical definition

The process of memory in which the information input through the sensory pathway can be stored persistently through the process of short-term memory, which persists for only 20 to 30 seconds. Long term memory is also labeled as secondary memory. The information stored in long-term memory is reproduced and reactivated, since it is stored in an organized form [5]. Long-term memory is not limited in its capacity, but refers to knowledge about factual information.

#### (2) Operational definition

We measured the long term memory of the educational content by giving a quiz to participants. The quiz was generated by the researchers and performed a week after providing education.

### 2) Short-term memory

#### (1) Theoretical definition

Memories and processes in which the information input through the sensory pathway are stored for a short period of time. It is called as short-term memory (also called primary memory). Short-term memory generally stores information for 20 to 30 seconds, and active information processing occurs during this period [5].

#### (2) Operational definition

We measured the short term memory of the educational content by giving a quiz immediately after providing

education.

### 3) Learning satisfaction

#### (1) Theoretical definition

Learning refers to a set of formal curriculum, the design of organizational and intentional learning activities, and the interaction between the environment, organization, programs, and learners [6]. Satisfaction is the generic favor or non-favorable feeling of the customer who is provided with the service. This is the customer's emotions felt by providing a set of formal curriculum [7].

#### (2) Operational definition

We measured learning satisfaction by using the survey instrument [8] which was applied in the educational study [9].

## 2. Research subjects and methods

### 2.1 Research design and procedure

This study is an experimental study to investigate the influence of smartphone application and written education paper on learning effect. Students of a university participated for the study. The experiment period was from May 1, 2018 to May 10, 2018. Poster and SNS were used to publicize the research participation. The experiment process was explained to the fifty participants, which gave their consent to participate in the study. They were able to withdraw it at any time if they wanted to stop participating in the experimental study.

Fifty participants were randomly assigned to the experimental group (24 patients) and the control group (26 patients). The contents of the training consisted of basic knowledge on the measurement of blood pressure and pulse taking. We developed the smartphone app using App Inventor 2.0. [Fig.1]. The experimental group were taught using the app and the control group were taught the same content using paper material at the same time. Both groups were given a quiz to measure the short-term memory. One week later, they were given the same quiz that they had solved a week before to measure long-term memory. Results of the quiz were compared between the experimental group and the control group. Learning satisfaction was surveyed through a set of questionnaires.

### 2.2 Participants

A poster advertisement provided to recruit freshman and sophomore majoring in nursing at a university. The participants were informed about the program and agreed to the program. We were able to conduct the experiments on all 50 people without dropouts.



Figure 1. Education contents sample screenshot

### 2.3 Data analysis method

SPSS 21.0 software was used to analyze the data. Frequency analysis was performed to compare the general characteristics of our experiment and control group. Since there were a couple of cells with small frequencies, we presented a Fisher's exact test result rather than a Chi-squared value. Short and long-term memory and learning satisfaction were analyzed by independent t-test. Since we used a relatively small sample (n= 24 in experiment, 26 in control group), non-parametric analysis might be more appropriate. Wilcoxon signed rank sum test, therefore, was performed and compared.

### 2.4 Ethical considerations

It was explained that the results of the research were used only for pure research purposes and that anonymity is ensured and that personal information of all individuals is thoroughly confidential.

## 3. Result

This study is a comparative study of experimental group and control group to investigate the effect of learning effect and satisfaction by educational media. The results are as follows.

### 3.1 General characteristics

Analysis of general characteristics of participants and homogeneity test results between experimental group and control group were as follows (Table 1).

The mean age of subjects was  $20 \pm 0.481$  years in the experimental group and  $18.962 \pm 0.188$  years in the control group, and the age of the experimental group was larger ( $t = 2.069$ ,  $p = 0.044$ ). The distribution of sex between the male and female subjects are 5 (20.8%) and 19 (79.2%) in the experimental group and 6 (23.1%) and 20 (76.9%) in the control group and there was no statistically significant difference ( $t = 0.188$ ,  $p = 0.852$ ). The composition of freshman and sophomore are 14 students (58.3%) and 10 students (41.7%) in the experimental group and 21 students (80.8%) and 5 students (19.2%) in the control group. In the control group, the ratio of freshman was high ( $t = 1.748$ ,  $p = 0.087$ ).

Regarding learning experience using smart phone, in the experimental group, 16 (66.7%) were experienced and 8 (33.3%) were inexperienced. In the control group, 14 (53.8%) had learning experience and 12 had none ( $t = -0.914$ ,  $p = 0.365$ ). Regarding memory power, the majority of students in the experimental group and the control group answered "normal" and there was no statistically significant difference ( $t = 1.464$ ,  $p = 0.150$ ). Regarding concentration, the majority of students in the experimental group and the control group answered "normal" and there was no statistically significant difference ( $t = -0.623$ ,  $p = 0.536$ ). Satisfaction with the major in nursing was 6.729 in the experimental group and 6.461 in the control group, but there was no statistically significant difference ( $t = -0.914$ ,  $p = 0.365$ ). This shows that the general characteristics of the experimental group and the control group participating in this study are homogeneous except for the age and grade distribution.

**Table 1. Homogeneity test for treatment group (app users) and control group (Conventional paper material users)**

Variables		Treatment (n=24)	Control (n=26)	Fisher's exact	
		n(%) / Mean±SD	n(%) / Mean±SD	t	p
Age (year)		20±0.48	18.96±0.19	2.069	0.044
Sex	Man	5 (20.8)	6 (23.1)	0.188	0.852
	Woman	19 (79.2)	20(76.9)		
School year	1st	14(58.3)	21(80.8)	1.748	0.087
	2nd	10(41.7)	5 (19.2)		
Memory	Moderate +	15(62.5)	21(80.8)	1.464	0.15
	Bad	9 (37.5)	5 (19.2)		
Concentration level	Moderate+	19(79.2)	17(64.8)	-0.623	0.536
	Bad	5 (20.8)	9 (35.2)		
Smartphone use habit	Often	11(45.8)	6 (13.0)	-0.914	0.365
	Sometimes	5(20.8)	8 (30.8)		
	Never	8 (33.3)	12(46.2)		
Satisfaction with major		6.73±0.23	6.46±0.32	-0.914	0.365

### 3.2 Differences in Learning Effectiveness and Satisfaction

Comparison results between experimental group and control group regarding learning effectiveness and satisfaction are as follows (Table 2).

The short-term memory score for measuring the learning effect was 0.227 points higher in the experimental group (6.458 points) than in the control group (6.231 points), but there was no statistically significant difference ( $t = 0.422$ ,  $p = 0.675$ ). Long-term memory scores, another outcome variable for measuring learning effects, were 0.721 points higher in the experimental group (5.875 points) than in the control group (5.154 points), but not statistically significant ( $t = 1.006$ ,  $p = 0.320$ ). The learning satisfaction was 2.95 points higher than the control group (32.83 points) after the intervention ( $t = 2.322$ ,  $p = 0.024$ ). To summarize the above results, it can be seen that the learning through the smartphone application was not higher than the learning through paper material, but the learning satisfaction was higher when using smartphone application.

**Table 2. Comparison of Short-term Memory, Long-term Memory and Study Satisfaction between treatment group (app users) and control group (Conventional paper material users)**

Variable	Treatment (n=24)	Control (n=26)	t	p
	Mean±SD	Mean±SD		
Short-term memory	6.46±2.17	6.23±1.63	0.422	0.675
Long-term memory	5.88±2.64	5.15±2.43	1.006	0.320
Educational satisfaction	32.83±5.06	29.88±3.84	2.322	0.024

### 3.3 Further analysis of learning effects

The short-term memory and long-term memory results were not significantly different from the

independent t-test results. We also performed Wilcoxon signed rank sum test to compare to the t-test result and found that the Z static from Wilcoxon test was not significant either. Next, ANCOVA analysis was performed. With controlling the effect of grade, our short-term memory score appeared statistically significant ( $p < 0.01$ ). Also found a significant difference for the long-term memory score between our treatment and control group ( $p < 0.01$ ).

#### 4. Discussion

The purpose of this study was to evaluate the possibility of using smartphone learning applications as a method to improve learning effect (short term and long term memory of learning contents) and learning satisfaction. We found that the nursing students' learning satisfaction was higher in learning method using smartphone app rather than paper method. Nursing students might realize that the app is a cost effective way to learn a nursing skill (blood pressure reading and pulse taking for this study). According to previous studies, satisfaction with smartphone applied education is due to the fact that it can save time and does not either a trained specialist or a suitable specific location [4, 6]. There are many health professionals who have attempted to incorporate smartphones into medical education. Our findings suggest that the similar approach to smartphone applied education enable medical students and patients to satisfy with what they are taught.

In contrast to the effect on learning satisfaction, the short term and long term memory scores did not show statistically significant difference between the two methods (Table 2). This result could be explained as follows. First, this study was conducted in a small group of 24 experimental and 26 control groups. When sample sizes are not big enough, study results often get affected by various factors related to an outcome variable. There may be a more significant factor determining our outcome variable (short term and long term memory scores) than our experimental treatment (an education method). In fact, the memory scores were significantly different between a freshman and a sophomore among the study participants. In short term memory, the freshman's score was  $5.63 \pm 1.66$  and the sophomore's score was  $8.00 \pm 1.25$ . The long term memory score was  $4.31 \pm 1.82$  in the freshman grade and  $8.27 \pm 1.62$  in the sophomore. The learning content provided in this study might be what the sophomore had already learned through their academic course and the freshman had not.

Second, there are some study participants who used their own Android smartphone and others used the smartphone provided by the experimenter because the learning app was not run on their iPhone smartphone at the time of the experiment. Better results could come if used their own smartphone that is easy to operate and familiar with.

Third, the content of the study was limited to a single theme of blood pressure measurement and pulse taking. If we have tried different contents, we may see different research results derived.

This study has several limitations.

First, the research subjects are limited to the freshman and sophomore of E University nursing college students, and care should be taken to generalize the results of the study because the grades of experimental group and control group are not homogeneous. Repeated researches are required to expand the number of subjects, grades, gender, and the scope of the school.

Second, the experimental period was short. Further research is needed to see what effect the smartphone application learning will have on when experiment is performed on the long time period.

Third, in this study, it is expected that the experiment period and the midterm exam period overlapped and the subjects were burdened with the study, and physical and mental stress and fatigue were high. This may have affected the outcome of the study.

#### 5. Conclusion

Research on the effects of smartphone-based education in the medical field, especially nursing, is still in its early stages. In other areas, research on smartphone-based educational effects versus traditional methods of education has been conducted in many places. Our research can help show that app-based training is more effective in nursing training field. The purpose of this study was to examine the effect of smartphone app-based education for nursing university students. Our experimental study results showed that students' learning satisfaction was higher when using smartphone app than using conventional paper-based learning method. Also found that their short term and long term memory of the educational contents were higher after controlling for covariates. Once established, the same application may be applied for another setting to teach nursing skills. Although applying the app for college students, we could use it for on-the-job training for nurses. People could make it applicable for patients who need to learn self-care skills. By allowing the patients using the education material at home, the use of nursing app could be expanded.

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