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A Mobile Learning Approach to Promoting Students' Learning Performances in The Era of The Pandemic

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Abstract: Educators have indicated the need to foster students' ability to solve problems by acquiring up-to-date knowledge as well as promoting their competencies for making decisions from diverse perspectives based on the acquired knowledge. Traditional courses mainly use lecture-based instruction without providing sufficient opportunities for students to practice and interact with the teacher; therefore, it is difficult to deliver such up-to-date knowledge via traditional instruction, not to mention fostering students' critical thinking. In this study, a Mobile technology model is proposed to address this problem. Moreover, a learning system is developed based on the proposed approach. To evaluate the effectiveness of the proposed approach, a quasi-experiment was conducted in a university with a two-group pre-test post-test design to assess participants' learning achievement and critical thinking. The participants were two classes of undergraduate students. One class with 37 students was the experimental group learning with the Mobile technology learning approach, while the other class with 37 students was the control group learning with the conventional technology-based learning (CTL) approach. Analysis of covariance (ANCOVA) was performed to evaluate the effect of the intervention on the target outcomes. It was found that the experimental group showed better learning achievement and critical thinking than the control group. This implies that the Mobile technology approach has good potential in helping learners think from diverse perspectives and promoting their learning performance and engagement, which is important in higher education aimed at fostering students' competence in acquiring up-to-date knowledge for solving problems.

Keywords: Decision making, mobile learning, critical thinking, mobile applications

1. Introduction

Fostering students' ability to solve problems by acquiring up-to-date knowledge as well as assessing the acquired content from diverse perspectives has been emphasized by educators as important competencies in the 21st century (Albahlal, 2019). From the perspective of constructivism and connectivism, shifting the power in education away from individuals, such as learners and instructors, to a collective group is important (Bozkurt, 2017). It closely aligns to learning that harnesses technology to take learners beyond the walls of the classroom, such as handheld devices and VR (Thongkoo, Panjaburee, & Daungcharone, 2019). Connectivism is positioned as a new philosophy of education for the digital age (Siemens & Conole, 2011). It makes Vygotsky's concept of the zone of proximal development (ZPD) more flexible as well as expanding it to include learning that lies outside the learner, in social networks and technological tools (Mattar, 2018). For example, Cavus and Uzunboylu (2009) pointed out the importance of fostering students' ability to acquire up-to-date knowledge in a mobile web learning environment. In traditional instruction for undergraduate students, teachers generally deliver the content of textbooks and some illustrative cases reported in research articles in a lecture-based mode. In such a learning mode, students have few opportunities to acquire knowledge on their own, not to mention learning to make judgments using the acquired knowledge (Lai & Wu, 2012). Scholars have therefore pointed out the need to shift the educational paradigm to the learner-centered mode, which encourages students to acquire up-to-date knowledge from diverse channels (Schutte et

al., 2017). In the era of mobile and wireless communication, such a knowledge-acquiring mode is very important, in particular in the time of the COVID-19 pandemic (Onyema et al., 2020). We introduced the Mobile technology approach in an attempt to overcome the shortcomings of the conventional learning approach and ultimately to enhance students' learning achievements and critical thinking. To verify the efficacy of this model, we used a quasi-experiment to answer the following research questions:

1. How does the Mobile technology learning approach influence student learning achievements in comparison with the conventional technology-based learning (CTL) approach?
2. How does the Mobile technology approach influence student critical thinking in comparison with the CTL approach?

2. Quasi experimental design

2.1 Participants

The participants were two classes of undergraduate students taking a nutritional assessment course at a nursing school in Taiwan. The course is a compulsory basic nursing course in schools and hospitals and is a necessary part of nursing training. One of the classes with 37 students was assigned to be the experimental group using the Mobile technology approach, while the other class with 37 students was the control group learning with the CTL approach. Both classes were taught by the same instructor who had more than 10 years' experience of teaching nutritional assessment and nursing courses. The average age of the students was 21 years old. Pre- and post-test experiments were designed to compare the two groups of students' learning achievement, and critical thinking.

2.2 Experimental procedure

This quasi-experiment was conducted over a period of 4 weeks (two sessions with a total of 100 minutes each week). In the 1st week, the students received the pre-test and pre-questionnaires after learning the basic knowledge of the course unit. In the 2nd and 3rd weeks, the lecturer first introduced the nutritional assessment course and explained the activity and case study instructions. Students were asked to provide nutritional assessments and suggestions based on each case, then took the pre-test and critical thinking pre-questionnaire to understand the students' relevant prior knowledge and feelings. During this learning stage, the experimental group learned with the Mobile technology approach for the nutrition assessment course. Conversely, the control group learned through the CTL approach; that is, teachers used the Daily Diet Guide and PPT (PowerPoint) to explain the content and cases. The content learned by the two groups of students was the same. The worksheet included information about whole grains, beans, fish, eggs, meat, dairy products, vegetables, fruit, oils, nuts, and seeds, and to practice nutritional evaluation skills for providing dietary suggestions. During the practice and discussion stage, both groups of students could then ask and discuss any nutritional assessment questions with teachers or classmates. This enabled peers to practice with each other according to the worksheet.

2.3 Experimental Results

This study used the pre-learning test as the covariate for analysis and the post-learning test as the dependent variable. The Levene's test revealed that the homogeneity assumption was confirmed for learning achievement F (1, 70) = 0.04 ($p > 0.05$). In addition, after verifying that learning achievement scores F (1, 72) = 8.75 ($p > 0.05$) complied with the assumption of regression homogeneity, we used ANCOVA for post-hoc analysis of the scores of the two groups. Here, we used a visit method for ANCOVA analysis. As shown in Table 1, the learning achievement F (1, 71) = 22.87 (95% confidence interval 17.86 to 32.51; $p < 0.001$) results suggested that the intervention was effective. Students using the Mobile technology learning approach had better learning achievement results (mean = 88.66; *SD* = 10.84) compared to students learning with the CTL approach (mean = 63.47; *SD* = 19.55).

In addition, after verifying that critical thinking ratings F (1, 72) = 8.79 ($p > 0.05$) complied with the assumption of regression homogeneity, we used ANCOVA for post-hoc analysis of the scores of the two groups. Here, we used a visit method for ANCOVA analysis. The critical thinking F (1, 71) = 44.57 (95% confidence interval 0.87 to 1.38; $p < 0.001$) results suggest that the intervention was

effective. Students using the Mobile technology approach had better critical thinking results (mean = 4.56; SD = 0.52) compared to students learning with the CTL approach (mean = 3.43; SD = 0.58).

Table 1. *learning result of learning achievement and critical thinking*

Variance	Group	*N*	Mean	*SD*	Adjusted mean	*Std. error.*	*F*	*η2*
Learning achievement	Experimental group	37	88.66	10.84	85.81	2.69	22.87***	0.244
	Control group	37	63.47	19.55	66.32	2.69		
Critical thinking	Experimental group	37	4.56	0.52	4.41	0.08	44.57** *	0.386
	Control group	37	3.43	0.58	3.58	0.08		

***$p < .001$

3. Discussion and Conclusions

The contribution of the present study is to propose the Mobile technology learning approach and examine the effectiveness of guiding students to make decisions, acquire up-to-date knowledge via mobile applications, and make reflections before doing exercises in professional training programs. By associating the statements in the literature review and the discussion, it was found that the Mobile technology approach can be fully supported by the literature and several educational theories. More importantly, the barriers to implementing the Mobile technology approach in professional training are low, and hence the findings of the present study could be a good reference for those who intend to conduct research and instruction in professional training programs in the future. In particular, in the time after the pandemic, the findings could be a good reference for helping students learn how to keep track of the pandemic and make suitable decisions to protect themselves and their families. As suggested by several scholars, educating students to learn up-to-date knowledge is very important in the pandemic and post-pandemic eras.

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