Yang, J. C. et al. (Eds.) (2018). Proceedings of the 26th International Conference on Computers in Education. Philippines: Asia-Pacific Society for Computers in Education

The effectiveness of integrating adaptive learning platform with flipped classroom in students' learning performance and self-learning approach

Chia-Ching LIN[a] , Ying-Tien WU[b*]
[a]*Graduate Institute of Science Education and Environmental Education, National Kaohsiung Normal University, Taiwan*
[b]*Graduate Institute of Network Learning Technology, National Central University, Taiwan*
*ytwu@cl.ncu.edu.tw

Abstract: This study explored the effectiveness of integrating adaptive learning platform with flipped classroom in students' learning performance and self-learning approach in an elementary Biology course. A quasi-experimental research design was conducted to the participants of 110 elementary school students from Northern Taiwan. An adaptive learning platform integrating flipped classroom instruction was applied in the experimental group, and a relatively lecture instruction was conducted to the control group. The instruments of achievement test and self-reported questionnaire were used to assess the students' learning performance and self-learning approach. A series of t-tests were used to examine the differences of prior knowledge, learning performance and self-learning approach between the groups. The findings revealed that students in the experimental group had higher learning performance and lower test anxiety than the others in the control group.

Keywords: Adaptive learning, flipped classroom, self-learning

1. Introduction

Adaptive learning aims to provide every learner personalized course in response to their learning needs. The mechanism of adaptive dynamic assessment has been employed to detect learners' knowledge base at first, which provides the guidance of remedial instruction according to one's learning needs. To amplify the benefits of 1-on-1 mentorship in adaptive learning, instructional videos should be carefully designed to support learners' own personalized course. Oliver and Trigwel (2005) proposed that multimedia tools should be appropriately integrated with different instructional plans adopted in traditional teaching to support hybrid learning. Form the cognitive perspectives, many studies contended that the implement of video could enhance students' motivation, memorization, content understanding and decision-making (Choi & Johnson, 2007; Tamim, Bernard, Borokhovski, Abrami, & Schmid, 2011). The three-stage learning cycle involving the stages of concept exploration, introduction and application is a science teaching model developed for the first time by the US science curriculum improvement study (SCIS), originally known as Exploration-Invention-Discovery (Karplus & Their, 1967). Many empirical studies have shown that the three-stage learning cycle teaching model not only enhances students' understanding and memory of scientific concepts, but also scientific thinking, process skills, reasoning ability and enthusiasm for scientific practice (Lawson, Abraham, & Renner, 1989; Musheno & Lawson, 1999; Gerber, Cavallo, & Marek, 2001).

In contrast to teacher-centered instruction in the conventional classroom, the teaching method of "Flipped classroom" addresses a learner-centered environment that learners can determine the pace, sequence, and content of one's own learning (Hamid, 2002). The basic concept of the flipped classroom advocates that students can preview the course materials on video according to one's own learning pace, and take notes to record any problems for further clarification in the conventional classroom (Bergmann & Sams, 2012). While the students get the initial understanding of course content, teachers can help students clarify their questions about the course

topic and content, and engage them in classroom activities addressing inquiry and problem-solving in practice. In the scenario of flipped classroom, students are encouraged to self-study through the video-enhanced platform, and the time in the classroom is used for a wide range of practical activities and problem-solving (Bergmann & Sams, 2012). Consequently, teachers will put more time and attention to students' clarification of alternative concepts and development of individual knowledge (Bergmann & Sams, 2012).

With the growing attention on STEM education, basic science education requirements would be critical to the application of science to real-world problems and challenges, especially for those non-science-major students. While exposing diverse student populations to STEM topics, the application of adaptive learning can help them learn in ways that best meet their learning preferences and trajectories. Various modes of learning available in the classroom may bridge achievement gap in STEM education. Moreover, students' management and control of their effort on the learner-centered environment is critical to their learning and academic performance. While students have plenty of opportunity to control their learning process, they would be responsible for behavioral motivation and cognitive understanding through self-learning (Pintrich, 1999). Students' perceptions of self-learning may reveal their behavioral and cognitive engagement with the involved learning activities to reach the completion of and the success in learning (Schunk, Meece, & Pintrich, 2012). Research findings also reveal that the students with self-learning approach could have better learning performance (Boekaerts, Pintrich, & Zeidner, 2005). Thus, instructional method and environment may help students regulate one's own learning and develop self-learning approach, which can be critical to students' engagement in STEM-related subjects. In this regard, the purpose of this study is to integrate an adaptive learning platform with the flipped classroom in an elementary Biology course, and then examine its effectiveness in supporting students' self-learning approach.

2. Methodology

2.1 Participants

The 110 participants were recruited from four classes of an urban elementary school in Taiwan. Two of four classes were randomly assigned as an experimental group (n=54), and the other as a control group (n=56). The students were instructed by a same female teacher majoring in Biology and having 15 years of teaching experience.

2.2 Research procedure

A quasi-experimental design was conducted in this study. The instruction integrating adaptive learning platform with flipped classroom was conducted to the experimental group students, whereas a conventional lecture was conducted to the control group students for the same Biology course unit. Before entering the one-week Biology course, all students in both experimental group and control group took a pre-test to assess their prior knowledge. The post-tests of assessing learning performance and self-learning approach were conducted to all students in the end of curriculum.

2.3 Instruments

An adaptive learning platform shown in Figure 1 was employed to support the students' Biology learning in the experiment group. While logging into the system, the instructional videos were assigned to each student based on the pre-test performance, as shown in Figure 2. The instructional videos were developed in light of learning cycle theory, including the phases of questioning for concept exploration, lecture for concept clarification, and extended application for concept consolidation. In addition, the Chinese-version questionnaire of self-regulated learning (Pintrich & De Groot, 1990) was exploited to assess students' perceptions of and approaches to self-learning toward science. The questionnaire includes 43 items categorized into five dimensions of self-efficacy, intrinsic value, text anxiety, cognitive strategy use and self-regulation. All of the items were presented on a 1-5 point Likert scale, from 1 (strongly disagree) to 5 (strongly agree). Students' Biology exam score was used to represent their prior knowledge. In addition, a post-test including 25

multiple-choice items was employed to assess the students' learning performance of Biology after the courses.

Figure 1. The student's interface of adaptive learning platform

Figure 2. The assignment of instructional videos

2.4 Data collection and analysis

The participants' responses to the questionnaire of self-learning were initially analyzed for the instrument reliability. The reliability (alpha) coefficient score for each scale is .90, .92, .90, .93, .90, and the overall alpha is .95. The results reveal that the questionnaire has satisfactory reliability in the assessment of students' self-learning. To explore the effectiveness of the instruction integrating adaptive learning platform with flipped classroom in self-learning, the method of independent t-test was conducted.

3. Results

A series of t-tests were employed to examine the differences of learning performance and self-learning approach between the groups. Table 1 reveals the data on students' prior knowledge, post-test performance and responses to the dimensions of self-learning approach. An insignificant difference of prior knowledge between the groups (82.65 versus 82.77, n.s.) reveals that the students in both groups have a similar level of knowledge base. Accordingly, a further comparison of post-test performance reaches a statistically significant level of difference ($t=5.66$, $p<0.001$) between the groups. The results reveal that the students in the experimental group have better

learning performance than the others in the control group (26.15 versus 19.84), which informs the effectiveness of integrating adaptive learning platform with flipped classroom.

Moreover, the results in Table 1 also revealed that these two groups of students had significant differences in test anxiety ($t=-2.34$, $p<0.05$); however, no significant difference was found in other dimensions of self-learning approach. The students in the experimental group expressed lower test anxiety than the other students in the control group. The result suggested that integrating adaptive learning platform with flipped classroom may be helpful to reduce students' anxiety about science examination in light of the remedially customized instruction.

Table 1. The comparisons of students' prior knowledge, post-test performance and self-learning approach between the groups.

	Experimental Group (n=54) Mean/S.D.	Control Group (n=56) Mean/S.D.	t-value
Prior knowledge	82.65/10.71	82.77/9.73	-0.06
Post-test Performance	23.15/2.27	19.84/3.72	5.66***
Self-efficacy	3.74/0.60	3.63/0.75	1.53
Intrinsic Value	3.78/0.73	3.88/0.76	-0.77
Test Anxiety	3.21/0.97	3.66/0.93	-2.34*
Cognitive Strategy Use	3.57/0.79	3.65/0.81	-0.52
Self-Regulation	3.47/0.78	3.54/0.91	-0.44

4. Conclusion

This study investigated the effectiveness of integrating adaptive learning platform with flipped classroom in supporting students' Biology learning and self-learning approach. The initial empirical results provided some evidence that adaptive learning platform could be helpful to students' science learning and self-learning approach in the aspect of test anxiety. By use of dynamic assessment and customized videos in adaptive learning platform, students could understand one's weakness in science knowledge and learn more efficiently. Furthermore, it could be suggested that a relatively learner-centered learning scenario (i.e., flipped classroom) may shape the development of students' self-learning approach. Appropriate knowledge base and proactive self-learning approach would be prerequisites for preparing various student populations in pursuing STEM education. Future studies could focus on exploiting adaptive learning platform to support various learning modes corresponding to different STEM fields.

Acknowledgements

This research was partially funded by Ministry of Science and Technology, Taiwan, under grant number MOST 106-2511-S-017 -001 -MY2, 104-2511-S-008 -015 -MY3, and 107-2628-H-008 -003 -MY4.

References

Bergmann, J., & Sams, A. (2012). *Flip your classroom: Reach every student in every class every day*. Eugene, OR: ISTE.

Boekaerts, M., Pintrich, P. R., & Zeidner, M. (Eds.). (2000). *Handbook of self-regulation.* San Diego: Academic Press.

Choi, H.-J., & Johnson, S. D. (2007). The effect of problem-based video instruction on learner satisfaction, comprehension and retention in college courses. *British Journal of Educational Technology, 38*(5), 885-895.

Gerber, B. L. Cavallo, A. L. & Marek E. A. (2001). Relationship among informal learning environments, teaching procedures, and scientific reasoning abilities. *International Journal of Science Education, 23*(5), 535-549.

Hamid, A. A. (2002). E-learning Is it the "e" or the learning that matters? *Internet and Higher Education, 4*, p311-316.

Karplus & Their (1967). *A new look at elementary school science*. Rand McNally, Chicago,II.

Lawson, A., Abraham, M. & Renner, J. (1989). A Theory of Instruction: Using the Learning Cycle to Teach Science Concepts and Thinking Skills. Manhattan, KS: National Association for Research in Science Teaching (NARST).

Musheno, B. V., & Lawson, A. E. (1999). Effects of learning cycle and traditional text on comprehension of science concepts by students at differing reasoning levels. *Journal of Research in Science Teaching.36*(1), 23-37.

Oliver, M., & Trigwell, K. (2005). Can 'Blended Learning' Be Redeemed? *E-Learning, 2*(1), 17-26.

Pintrich, P.R. (1999). The role of motivation in promoting and sustaining self-regulated learning. *International Journal of Educational Research, 31*(6), 459-470.

Pintrich, P. R., & de Groot, E. V. (1990). Motivational and self-regulated learning components of classroom academic performance. *Journal of Educational Psychology, 82*(1), 33-40.

Schaik, P. V., Barker, P., & Beckstrand, S.A comparison of on-campus and online course delivery methods in southern Nevada. *Innovations in Education and Teaching International, 40*(1), 2003, 5-15.

Tamim, R. M., Bernard, R. M., Borokhovski, E., Abrami, P. C., & Schmid, R. F. (2011). What forty years of research says about the impact of technology on learning: A second-order meta-analysis and validation study. *Review of Educational Research, 81*(1), 4-28.