Exploring the Effectiveness of a Flipped Classroom Based on Control-Value Theory: A Case Study

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Abstract: Flipped classroom is a newly emerged video-lecture-supported teaching approach that aims to improve learning outcomes and teaching effects though students' self-regulated learning after class, teachers' assistance and interaction during class. In this paper, we explored the effectiveness of a flipped-classroom Java Programming course based on control-value theory in a university of China. The specific goal of this case study was to explore students' achievement emotion in this flipped classroom setting and explore the correlation among the given factors. Adopting a mixed method, this study collected data on students' Java self-efficacy (control), motivation (value), achievement emotion, self-regulated learning ability learning outcomes as well as open questions about attitudes and suggestions to flipped classroom. And students' learning outcome was multi-dimension evaluated, including self-reports after each project, assignments, online activities participate and final exam. The findings showed that the control-value theory could explain the effectiveness of the flipped classroom well. In addition, implications were also concluded from this study.

Keywords: Flipped classroom, control-value theory, effectiveness, case study

1. Introduction

Over the past decades, the public were dissatisfied with teaching effects of traditional approaches. With the development of newly emerged information technology, video-lecture can help students learn by themselves. Flipped classroom is based on a student that arrives to class ready for the learning experience and prepared by watching the video-lectures provided by the teacher in advance (Bristol, 2014). Nowadays, more and more researchers are focusing on the different parts of flipped classroom to transform the traditional education system together with MOOC and micro-video. This study mainly explored the effectiveness of flipped classroom based on control-value theory put forward by Pekrun (2006) focusing on exploring students' achievement emotion and its antecedents and effects.

2. Background

2.1 Flipped classroom

The conception of flipped classroom can be traced back to 2008, the chemistry teachers at Colorado's Pike's Peak, veteran Woodland Park High School came to the idea to provide video records of their lessons online for those absent students to see what they missed (Tucker, 2012). And it soon became very famous for its concept of having students to learn self-paced. Bishop and Verleger (2013) provided a comprehensive survey study of flipped classroom and concluded that a) most researches aimed to explore students' perceptions and use single-group designs; b) students' attitude generally positive overall, although they tent to in-person lessons to video lectures and c) little work investigating students learning outcomes objectively.

2.2 Control-Value theory

Control-Value theory was first put forward by Pekrun. It focused on achievement emotion and aimed to analyze the antecedents and effects of emotion experience in achievement and academic setting (Pekrun, 2006). Various factors were concluded in this comprehensive framework, such as expectancies, attributions, intrinsic/extrinsic value, achievement emotions, outcome emotions, self-regulation of learning and so on (Pekrun et al., 2007). By using control-value theory, we can improve the understanding of students' motivation, learning, performance (Artino Jr, 2012) and engagement (Buff, 2014).

The control dimension for the students learning a course factor often refers to their expectancies, attributions and confidence, such as self-efficacy (Pekrun et al., 2007). Self-efficacy was defined as people's judgments of their capabilities to organize and execute courses of action required to attain designated types of performance (Bandura, 1986; Askar and Davenport, 2009).

The value dimension of the course is both instinct and extrinsic (Pekrun et al., 2008). Motivation can explain the students' judgments of the course value for their own. ARCS model was a comprehensive motivation model includes attention, relevance, confidence and satisfaction for teachers develop qualified material for students in online or blended learning environment (Keller, 2010). And another factor can influence the students perceiving the value of courses is their technology acceptance. TAM is a framework measuring users' perceived and intention of using technology (Davis et al., 1989).

Achievement emotions are also intimately involved in virtually every aspect of the teaching and learning process and, therefore, an understanding of the nature of emotions within the school context is essential (Schutz and Lanehart, 2002). In the control-value theory, achievement emotion is defined as emotion tied directly to achievement activities or achievement outcomes, includes enjoyment, joy, relaxation, anger, frustration, boredom, shame, hope, pride, relief, anxiety, sadness, disappointment, hopeless and so on (Peruk, 2007).

Self-regulated learning is an important aspect of students' academic success (Effeney et al., 2013; Zimmerman, 2002). According to Zimmerman (2002), self-regulated learning is actions directed at acquiring information or skill that involve agency, purpose, and instrumentality self-perceptions by a learner. And it was cited as the effects of achievement emotion (Peruk et al., 2007).

2.3 The research framework

According to the control-value theory, we put forward a framework for this study showed as following (see Figure 1). The aim of this study was mainly focused on exploring achievement emotion and testing the framework in a flipped classroom as a pre study for the further exploration of effectiveness of this newly emerged teaching approach in the coming semester. As mentioned above, the control and value dimension had several factors, and this study only considered students Java self-efficacy as the control factor, while course motivation as the value factor.

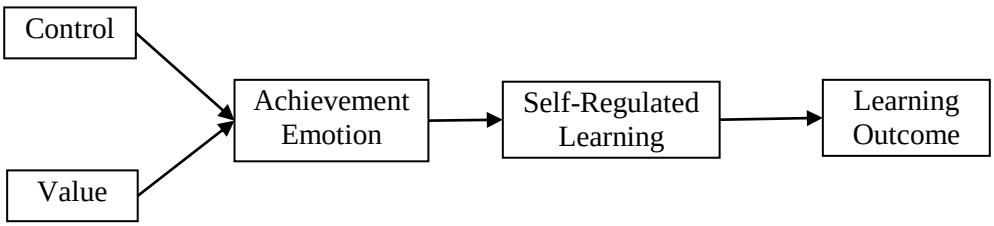


Figure 1. The Research Framework Based on Control-Value Theory.

3. Methodology

3.1 The study

The research reported here was taken in Shanghai, China that aimed to facilitate students' learning and enhance teachers' teaching by changing their roles during and after classes. There were totally 21 students (6 Male, 15 Female) including 9 sophomore and 12 junior students majoring Educational Technology in a normal university in Shanghai participated in this study.

3.2 The pedagogy

This research was taken in a flipped classroom setting. The students were asked to learn Java programming course by self-regulated learning out of class. Students were divided into several groups to fulfill three projects assigned to them, with each group containing 2-3 person. During this course, each student was asked to finish 3 projects with their teammates. 4 weeks were given to finish the first project which contains 3 sub-tasks, and 5 weeks for the next with 4 sub-tasks and 9 weeks for the last one with 8 sub-tasks.

The teacher provided learning materials in advance on the learning platform (Sakai). The videos were limited up to 8 minutes, known as micro-video podcast. It was reported that this kind of micro-video could contribute to the students' learning interests and attention last longer in self-regulated learning environment. Besides, several other types of materials, such as pdf, doc as well as hyperlinks of Java API etc. were also provided for the students to facilitate their self-regulated learning. Students were encouraged to participate online activities such as posting, and discussing with each other. Students also needed to submit a self-report of performance after they finished each project.

The learning outcome of the participated students were multi-dimension evaluated, including self-reports after each project, assignments, online activities participation as well as final exam. The calculation of final learning outcome followed the given formula below:

Total Learning outcome=10% * 3 Projects + 10% (online activities and self-report) + 60% final exam score.

3.3 The methods

Adopting a mixed method, this research used instruments which contained 12 items measuring students' Java self-efficacy adapted from Askar and Davenport (2009), 16 items measuring motivation adapted from TAM (Davis et al., 1989; Saadé and Bahli, 2005) and IMMS based on ACRS motivation model (Keller, 2010), 21 items measuring the achievement emotions adapted from the Achievement Emotions Questionnaire (AEQ) (Pekrun et al., 2011), 19 items measuring self-regulated learning ability adapted from Barnard et al. (2009) as well as open questions about attitudes and suggestions to flipped classroom. Collected data including the factors list above in this flipped classroom setting presented on a seven-point Likert scale, from strongly agree to strongly disagree, as well as demographic variables. All of the items in these questionnaires were adopted from existing scales in English, and then translated to Chinese for the participants, so the reliability of the questionnaires were guaranteed. Both quantitative and qualitative methods were adopted in this study. Descriptive and inferential statistics were used to analyze the structured questionnaires., while content analysis was used to coding the open questions.

4. Results

Only 19 students answered the Java self-efficacy and motivation scales effectively; 20 of them answered the achievement emotion and self-regulated learning scales effectively and 18 students answered all of the scales. The reliability of the questionnaires on students Java self-efficacy, motivation, achievement emotion, and self-regulated learning were good, Cornbash's α were 0.93, 0.93, 0.95, 0.74 respectively.

4.1 The result of self-efficacy

In this research, the Java self-efficacy (control dimension) scale was divided into three levels from basic understanding of Java Programming to confidently finishing a comprehensive Java project gradually, and each level contains 4 questions. The Min, Max, Mean and SD of each item were listed in the table 1 below. The total cornbash's α was 0.93, and 0.75, 0.70, 0.91 for level 1, 2, and 3 respectively.

Table 1: The result of self-efficacy scales (N=19).

Construct	Item	Min	Max	Mean	SD
Level 1	L1-01	3	6	4.21	0.85
	L1-02	3	7	4.63	1.16
	L1-03	3	6	4.74	0.81
	L1-04	3	6	4.84	0.96
Level 2	L2-01	2	6	4.11	1.15
	L2-02	2	5	4.11	1.05
	L2-03	3	6	4.21	0.79
	L2-04	2	6	4.37	1.12
Level 3	L3-01	2	5	3.74	0.93
	L3-02	3	7	5.11	1.10
	L3-03	1	6	4.37	1.16
	L3-04	2	7	4.32	1.20

4.2 The result of motivation

The course motivation scale (value dimension) contained five parts, such as: perceived ease of use, perceived of useful, intention to use, attention and relevance. The Min, Max, Mean, and SD of each item were listed in the table 2 below. The total cornbash's α was 0.93, and 0.87, 0.83, 0.74, 0.55, 0.84 for the five different parts mentioned above respectively.

Table 2: The result of motivation scales (N=19).

Construct	Item	Min	Max	Mean	SD	Construct	Item	Min	Max	Mean	SD
Perceived Ease of Use	PEU1	2	5	3.74	1.10	Attention	ATT1	3	7	4.84	1.01
	PEU2	2	6	4.58	1.35		ATT2	4	7	5.74	0.94
	PEU3	1	6	4.53	1.43		ATT3	2	7	4.63	1.34
Perceived of Useful	PU1	2	6	4.32	1.29		ATT4*	3	7	4.68	1.34
	PU2	2	6	4.32	1.11	Relevance	REL1	1	6	4.53	1.39
	PU3	2	6	4.16	1.17		REL2	3	7	5.21	0.92
Intention to Use	IU1	2	7	5.00	1.41		REL3	3	7	5.47	1.02
	IU2	2	7	4.68	1.34		REL4	3	7	4.95	1.08

*The items were assessed conversely.

4.3 The result of achievement emotion

The total cornbash's α of achievement emotion was 0.95, and 0.87, 0.34, 0.71, 0.84, 0.96, 0.85, 0.68 for enjoyment, hope, pride, hopeless, anxiety, boredom, and angry respectively. There were no cornbash's α of shame and relief parts, because there was only one item for both of this two parts. The Min, Max, Mean, and SD of each item were listed in the table 3 below.

Table 3: The result of achievement emotion scales.

Construct	Item	Min	Max	Mean	SD	Construct	Item	Min	Max	Mean	SD
Enjoyment	EM1	3	7	5.40	1.31	Anxiety*	ANX1	2	7	5.05	1.54
	EM2	2	7	4.75	1.16		ANX2	2	7	5.20	1.40
	EM3	3	7	5.20	1.15	Shame*	SM1	2	4	2.85	0.81
	EM4	4	7	5.50	1.05	Relief	RF1	1	6	4.00	1.41
Hope	HP1	1	7	4.05	1.40	Boredom*	BD1	3	7	5.70	1.03
	HP2	3	7	4.55	1.16		BD2	3	7	5.50	1.28
Pride	PD1	3	7	5.40	1.23		BD3	3	7	5.60	1.19
	PD2	3	7	5.05	1.05	Angry*	AG1	3	7	5.70	1.38
	PD3	3	6	4.55	1.15		AG2	3	7	5.20	1.47

Hopeless*	HPL1	3	7	5.70	1.30		AG3	4	7	5.50	1.05
	HPL2	2	7	5.10	1.48	N=20, Cronbach's Alpha=0.95					

*The items were assessed conversely.

4.4 The result of self-regulated learning

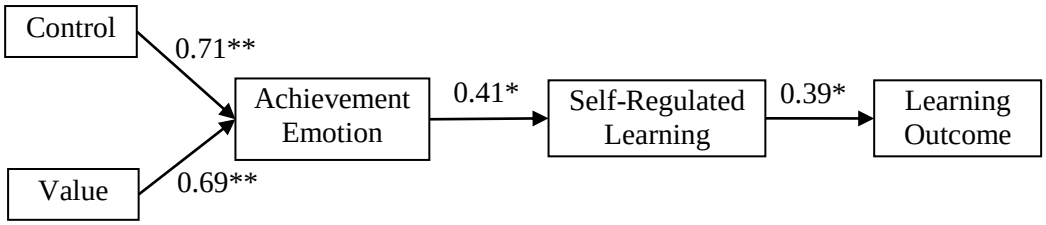
The total cornbash's α of achievement emption was 0.74, and 0.86, 0.73, 0.51, 0.58, 0.34, 0.63 for goal setting, environment structure, help seeking, time manage, task strategy, and self-evaluation respectively. The Min, Max, Mean, and SD of each item were listed in the table 4 below.

Table 4: The result of self-regulated learning scales.

Construct	Item	Min	Max	Mean	SD	Construct	Item	Min	Max	Mean	SD
Goal Setting	GS1	2	6	4.10	1.41	Time Manage	TM1	3	7	4.95	1.19
	GS2	1	6	3.55	1.40		TM2	2	5	3.60	1.05
	GS3	2	7	3.90	1.41		TM3	2	6	3.40	1.23
	GS4	2	6	4.15	1.23	Task Strategy	TS1	1	6	3.50	1.43
Environment structure	ES1	2	7	4.95	1.15		TS2	3	6	4.45	0.76
	ES2	4	7	5.15	0.99		TS3	2	6	4.30	1.13
	ES3	1	7	4.75	1.45	Self-Evaluation	SE1	2	6	3.85	0.99
	ES4	3	7	5.20	1.24		SE2	1	5	3.50	1.10
Help Seeking	HS1	2	7	5.25	1.29		SE3	1	5	4.20	1.11
	HS2	4	7	5.40	0.68	N=20, Cronbach's Alpha=0.74					

4.5 The result based on control-value theory

The correlation between students' Java self-efficacy (control) with their achievement emotion in flipped classroom setting was 0.77 (N=19, $p<0.01$, one-tailed); the correlation between motivation and achievement was 0.69 (N=19, $p<0.01$, one-tailed); the correlation between achievement emotion and self-regulated learning was 0.41 (N=20, $p<0.05$, one-tailed); the correlation between self-regulated learning with students' multi-dimension evaluated learning outcome is 0.39 (N=18, $p<0.05$, one-tailed) (see Figure 2).



** Correlation is significant at the 0.01 level;
* Correlation is significant at the 0.05 level.

Figure 2. The Results Based on Control-Value Theory.

5. Discussion and implications

As can be found in the data above, the students' achievement emotion in this study tend to be positive, for the Mean of each item was above the average (except 1 item). The results of other scales were also good and the correlations based on the framework were significant. When the students were asked whether they satisfied with their performance in this course or not, most of them still answered not too bad or general. It implicated that students could do even better and have potential of improvement in the flipped classroom. This made us confident to continue using this strategy in the coming semester, and develop more scaffoldings to support their learning.

Although the total reliability of the scales were good, but the reliability of some sub-constructs were not as good as the total because of the limited participates in this study. Actually, there were over

50 students participated in this course at the beginning, but most of them dropped out for the course pressure, limited time et al. This also showed that the students still had some resistance to this innovative teaching approach.

6. Conclusion

This study explored the effectiveness of a flipped classroom based on control-value theory. The study found that students' achievement emotion could be well explained using the framework of control-value theory and each the correlations between them were also significant.

The limitations of this study are listed as following, a) the sample size is small (only 21 participants); b) the alpha values of some scales were low, even though they were adopted from previous researches. Despite the limitations, this study severed as the pre study of the ongoing study of flipped classroom, and concluded many useful implications to the study will be take in the next semester to get a better knowledge of students' development based on control-value theory by using this innovative teaching strategy.

References

Artino Jr, A. R., Holmboe, E. S., & Durning, S. J. (2012). Control-value theory: Using achievement emotions to improve understanding of motivation, learning, and performance in medical education: AMEE Guide No. 64. *Medical teacher, 34*(3), e148-e160.

Askar, P., & Davenport, D. (2009). An Investigation of Factors Related to Self-Efficacy for Java Programming among Engineering Students. *The Turkish Online Journal of Educational Technology, 8*(1), 26-32.

Bandura, A. (1986). Social Foundations of Thought and Action. Prentice Hall, Englewood Cliffs, NJ.

Barnard, L., Lan, W. Y., To, Y. M., Paton, V. O., & Lai, S. L. (2009). Measuring self-regulation in online and blended learning environments. *The Internet and Higher Education, 12*(1), 1-6.

Bishop, J. L., & Verleger, M. A. (2013). The flipped classroom: A survey of the research. *In ASEE National Conference Proceedings*, Atlanta, GA.

Bristol, T. J. (2014). Flipping the classroom. *Teaching and Learning in Nursing, 9*(1), 43-46.

Buff, A. (2014). Enjoyment of learning and its personal antecedents: Testing the change–change assumption of the control-value theory of achievement emotions. *Learning and Individual Differences, 31*, 21-29.

Davis, F. D., Bagozzi, R. P., & Warshaw, P. R. (1989). User acceptance of computer technology: a comparison of two theoretical models. *Management science, 35*(8), 982-1003.

Effeney, G., Carroll, A., & Bahr, N. (2013). Self-Regulated Learning: Key strategies and their sources in a sample of adolescent males. *Australian Journal of Educational & Developmental Psychology, 13*, 58-74.

Keller, J. M. (2010). Motivational design for learning and performance. New York, NY: Springer.

Kong, S. C. (2014). Developing information literacy and critical thinking skills through domain knowledge learning in digital classrooms: An experience of practicing flipped classroom strategy. *Computers & Education, 78*(5), 160-173.

Pekrun, R. (2000). A social cognitive, control-value theory of achievement emotions. In J. Heckhausen (Eds.), *Motivational psychology of human development*. Oxford, UK: Elsevier Science,

Pekrun, R. (2006). The control-value theory of achievement emotions: Assumptions, corollaries, and implications for educational research and practice. *Educational Psychology Review, 18*(4), 315-341.

Pekrun, R., Frenzel, A. C., Goetz, T., & Perry, R. P. (2007). The control-value theory of achievement emotions: An integrative approach to emotions in education. Bibliothek der Universität Konstanz.

Pekrun, R., Goetz, T., Frenzel, A. C., Barchfeld, P., & Perry, R. P. (2011). Measuring emotions in students' learning and performance: The Achievement Emotions Questionnaire (AEQ). *Contemporary Educational Psychology, 36*(1), 36-48.

Saadé, R., & Bahli, B. (2005). The impact of cognitive absorption on perceived usefulness and perceived ease of use in on-line learning: an extension of the technology acceptance model. *Information & Management, 42*(2), 317-327.

Schutz, P. A., & Lanehart, S. L. (2002). Introduction: Emotions in education. *Educational Psychologist, 37*(2), 67-68.

Tucker, B. (2012). The flipped classroom. *Education Next, 12*(1), 82-83.

Zimmerman, B. J. (2002). Becoming a self-regulated learner: An overview. *Theory into practice, 41*(2): 64-70.