So, H. J. et al. (Eds.) (2020). Proceedings of the 28th International Conference on Computers in Education. Asia-Pacific Society for Computers in Education

Changes in the effect of concept map-based autonomous learning under different levels of self-regulation

Lu CHENG[a], Fan CHEN[a], Jiayu NIU[a], Xueying XU[a] & Ning MA[a*]
[a]*School of Educational Technology, Faculty of Education, Beijing Normal University, China*
*horsening@bnu.edu.cn

Abstract: This research is to explore the changes of concept map-based autonomous learning effect and its correlating with self-perceptions, motivational beliefs and the use of learning strategies which are the components of self-regulated learning. A mixed approach is employed with quantitative data from a self-regulation strategies questionnaire and evaluation of concept map, as well as qualitative data from a follow-up interview with thirty-three postgraduate students participated in this research. Our results indicate that the changes in the effect can be divided into three traces according to different trends, spikes and stability. Although it doesn't reveal the significant correlations of the level of self-regulation and changes in the effect, we find that students have perceived the factors that may affect their changes of learning performance. This study highlights the characteristics of the autonomous learning effect trend during a period of time, and contributes to the instructional use of concept map as well.

Keywords: Autonomous learning effects, Self-regulation, Concept map

1. Introduction

The focus of learning in schools gradually shifts from a knowledge-based to a skills-based curriculum to adapt to the high-speed social development (Oates, 2019). Accordingly, the ability of autonomous learning has attracted much attention. The gradual increase in the importance of autonomous learning places high demands on learners' self-regulation which is an integrated term referring to their motivational beliefs, metacognitive skills, and use of learning strategies (Cleary, & Platten, 2013).

Researchers have proposed numerous instructional strategies for improving self-regulation, such as the use of technology to support learning (Schraw, Crippen, & Hartley, 2006). Concept maps are often used, which is a support tool to affect autonomous learning through enhancing self-regulation strategies to varying degrees (Stevenson, Hartmeyer, & Bentsen, 2017). Novak (1984) thought learners utilizing concept maps in autonomous learning can not only monitor the process of their learning but also assess its outcomes. However, the effects on learning with concept maps are questionable, particularly for low self-regulated learners because autonomous learning requires a high degree of self-regulation to succeed (Dabbagh, & Kitsantas, 2004). Therefore, we attempt to explore the continuous changes in the effect of concept map-based autonomous learning under different levels of self-regulation, with the following questions: (1) How does the effect of learners' autonomous learning change toward concept map-based activities over time? (2) What is the correlation between autonomous learners' self-regulation and changes of learning effect toward concept map-based activities? (3) By follow-up interviews, how are the changes in autonomous learning effect influenced by self-regulation?

2. Method and Results

This research involved 34 first-year postgraduate students (32 females) participating in the same 18-week specialized course where autonomous learning took the form of English literature reading and concept mapping. During the autonomous learning, students read materials one week before class, and completed the knowledge construction based on concept maps. The evaluation of concept map includes

concepts (1 point), relationships (5 points), hierarchies (5 points), cross links (10 points), examples (1 point) and branches (1 point or 3 points) (Markham, Mintzes, & Jones, 1994). After the curriculum, study adapted the Self-Regulation Strategy Inventory-Self Report (SRSI-SR) (Cleary, 2006) to examine the frequency with which students engage in various adaptive and maladaptive regulatory behaviors. The modified SRSI-SR instrument (α=0.905) is still a 28-item scale utilizing a 7-point Likert scale.

To answer the first question, a second-order clustering is used to identify the whole features of changes in 8 concept maps scores per student, dividing the students into three traces (see Figure 1).

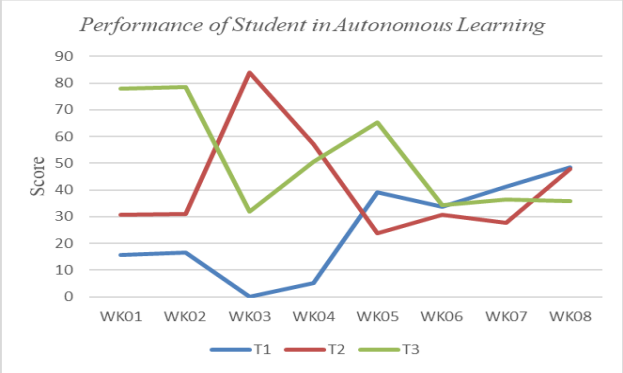

Figure 1. Performance of Student in Autonomous Learning

To reveal the differences of changes in learning effects under different levels of self-regulation, students were divided into three groups according to the self-regulation scores by the rate of 27%, 46% and 27% (Kelly, 1939). Then, according to Fisher's exact test results, there was no significant difference ($p>0.05$) between changes traces and self-regulation levels. To have a deeper understanding of the correlation, 4 typical interviewees were sampled from each cluster of the K-Modes clustering algorithm which presented the correlation between variables and similarity between samples (see Table 1).

Table 1. *Summary of cluster analyses of self-regulation level and traces of changes in learning effect*

	Clusters of learing behavior pattern		
	Cluster A (n = 22)	**Cluster B (n = 6)**	**Cluster C (n = 6)**
SR level	Level 2 (Middle)	Level 3 (High)	Level 1 (Low)
Change trace	1 (Low & steady)	3 (High, slowly falling)	3 (High, slowly falling)
Student ID	6, 27	8	11

From the thematic analysis results, two themes were extracted: self-perception, and the role of self-regulation in autonomous learning (see Table 2). The learning method had positive effects on students with high learning motivation (e.g., 8), but increased academic burden for students with low learning motivation (e.g., 11). Regarding the role of self-regulation, we found that the scores of students' concept map aiming at completing the task (e.g., 6) were generally low but slowly rose, while students whose main goal was to acquire knowledge (e.g., 8) had a good and stable learning effect. During the task, three types of help seeking behavior were captured: actively seeking external tool (e.g., 8), passively waiting for help (e.g., 27), and none attempting. When external support was not enough, students constantly adjusted their learning strategies to improve the learning effect (e.g., 8). Moreover, we found that some students with high self-regulation level had poor autonomous learning effect, which could be because they gave up self-regulation.

Table 2. *Categories of the attitude toward concept map based autonomous learning*

Categories	Themes	Example
Self-perception for the learning method	Motivations for learning	8: I should complete some learning task but don't do well, I will feel frustrated and failed to meet my requirements. 11: If I want to be motivated to learn, I need external stimulus.
The role of self-regulation in	Goal setting	6: My main task is to complete the concept map. 8: My learning goal is to understand the knowledge related to

concept map based autonomous learning		the learning sciences.
	Seeking external support	8: I often use translation software or consult relevant literature. 27: For what I don't understand, I would listen to class.
	Regulatory behavior	8: I found that reading and making concept map at the same time didn't help me much. So, I gave up this strategy later.

3. Discussion

Although previous researches have showed that self-regulation is the best predictor of academic performance (Young, 1996), we recognized from the quantitative analysis that the correlation of self-regulation and continuous performance in knowledge construction was statistically insignificant. The interview analysis indicated that some of the main self-regulated components did have an impact, for learners with specific self-regulation level and change traces were accustomed to use different SRL strategies (i.e., goal setting and help seeking). It is noteworthy that learners with better self-regulation usually took mastery as their personal goal, had specific plans, and tend to be more persistent and less likely to burn out over the long terms, which is consistent with previous studies (Wilson, & Kim, 2016).

However, many other factors (e.g., task difficulty, task value) were neither controlled nor focused because of the realistic conditions. In addition, the SRSI-SR scale in this research mainly measured learners' SRL strategies, but didn't exactly include the dimension of motivation beliefs which resulted in a long-term response. In this study, learners who had strong external motivation but failed to internalize in time gradually abandoned self-regulation though they had a high level of self-regulation. Thus, it is encouraged that studies be conducted to examine the influence of these variables.

Furthermore, this research used concept map as a support and assessment tool, but there was no specific investigation on how learners received and used the feedback from it. Future study could consider to explore the progress of using concept map as a cognitive and metacognitive tool.

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