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Investigating Active Learning Approaches on Students' Self-Regulation and Academic Performance in Flipped Learning Environments

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INTRODUCTION & AIM

Self-regulation is vital to learning due to its positive relationship with academic performance (e.g., Schneider & Preckel, 2017). Hence, it is imperative to understand how students' academic performance can be enhanced by improving their self-regulation through designing and integrating active learning approaches capable of enhancing self-regulation.

Collaborative learning is one of the most effective active learning approaches (Prince, 2004) and provides an effective learning experience (e.g., Niemi, 2012). Although some studies reported that collaborative learning develops and supports self-regulation through enhanced motivation (e.g., Järvelä et al., 2016), they focused on using personal strategies (i.e., time management). Studies have also shown that thoughtful integration of interactive online learning features engages and motivate students which enhances self-regulation (Van Laer & Elen, 2017). Research on learning approaches or activities to improve self-regulation is limited. This study aims to investigate the impact of active learning (collaborative and online interactive learning) on students' self-regulation and academic performance in the applied sciences context through a design-based research approach.

Research Question: How do active (collaborative and online interactive) learning approaches affect learners' self-regulation and academic performance?

METHOD

A mixed-method, equivalent time series design-based approach was employed. The Motivation Strategies for Learning Questionnaire (MSLQ) was used to measure self-regulation, while post-test scores were utilized to determine academic performance. This method was selected because:

1. Developing self-regulation is a gradual process that requires time.
2. Distinguish between the temporary enthusiasm caused by novelty and the genuine effectiveness of the treatment.
3. Observe trends and provide a more reliable assessment of the intervention's longitudinal impact.

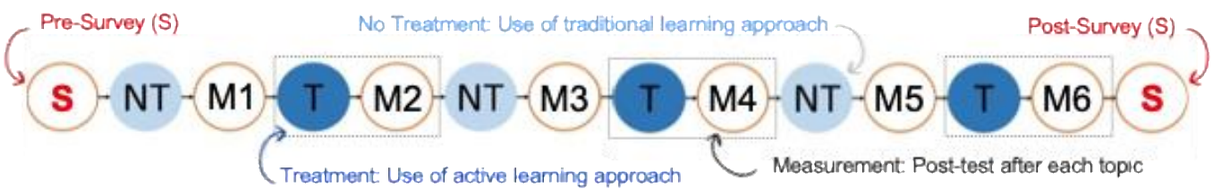

Figure 1. Illustration of the equivalent time series design.

Collaborative Learning

Students construct knowledge collaboratively by presenting new knowledge to the class in a green chemistry course.

- No Treatment (NT): Traditional teacher-centered instructions.
- Treatment (T): Collaborative knowledge improvement using the Funnel Model (Wen, 2019).

Online Interactive Learning

Students complete asynchronous online learning (AOL), developed based on the Community of Inquiry (CoI) framework in a general chemistry course.

- No Treatment (NT): Traditional teacher-centered (AOL).
- Treatment (T): Asynchronous online learning based on CoI.

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RESULTS & DISCUSSION

Post-test questions were created by the respective tutor-researcher with a maximum score of 10 marks (Figures 2 and 4). The survey items were adapted from the MSLQ and used a 7-point Likert scale (Figures 3 and 5).

Post-test scores (Figures 2 and 4) in the treatment periods (red lines) were consistently higher than the scores in the no-treatment washout period (blue lines) potentially due to cognitive diversity, leading to convergence and advancement of knowledge during collaborative learning (Wen, 2019). For online interactive learning, it could be due to learner agency. Comparing the scores of NT1 (first measurement) and the score of T3 (last measurement), there is a significant increase ($p < .05$) in student's academic performance for both activity learning strategies.

MSLQ results show generally significant improvement in student's self-regulation across most domains (Figures 3 and 5).

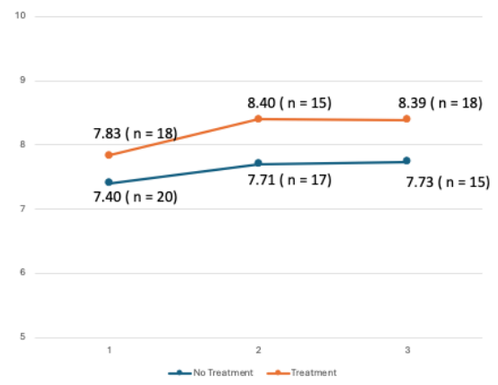

Figure 2. Post-test scores for collaborative learning

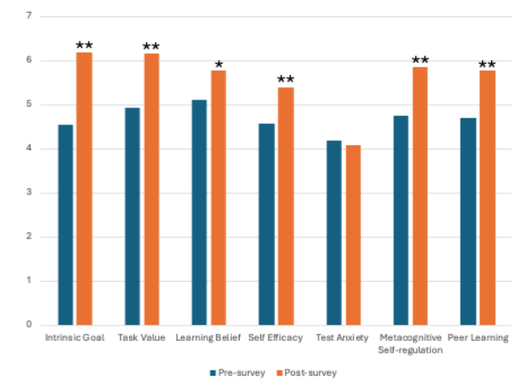

Figure 3. MSLQ results (n = 18). ** $p < .05$, * $p < .10$

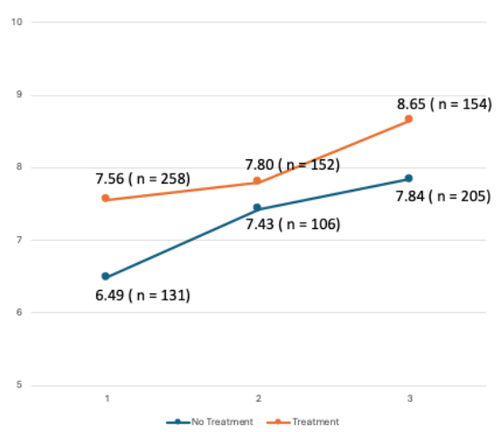

Figure 4. Post-test scores for online interactive learning

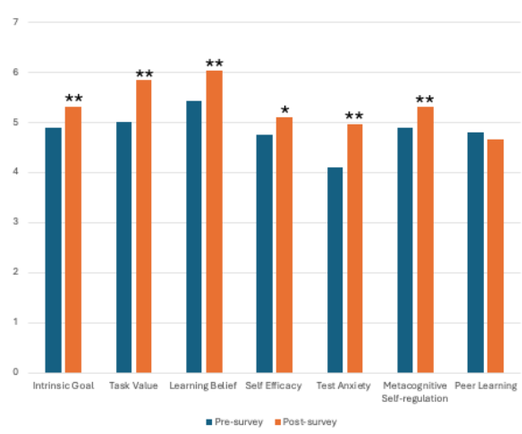

Figure 5. MSLQ results (n = 93/73). ** $p < .05$, * $p < .10$

Spearman correlations were generally non-significant, with active learning approaches showing significant relationships across different dimensions (Table 1). Significant correlations were positive but weak to moderate, suggesting that self-regulation is not a definitive predictor of academic performance, which may also be influenced by factors such as motivation.

Table 1. Spearman correlation between MSLQ dimensions and academic performance.

	Intrinsic Goal	Task Value	Learning Belief	Self Efficacy	Test Anxiety	Metacognitive Self-regulation	Peer Learning
Collaborative	-0.431	-0.120	0.495*	-0.064	0.235	0.162	-0.327
Online Interactive	0.125	0.140	0.019	0.093	-0.015	0.218*	0.275**

** $p < .05$, * $p < .10$

CONCLUSION & FUTURE WORK

Students identified strongly with domains of the questionnaire (intrinsic goals, task values, self-efficacy, metacognitive self-regulation, and peer learning) and are supported by students' qualitative feedback. Some of the design principles include:

- Collaborative learning:
  - **Scaffolding**: Allow students to experience a simplified process of the activity before letting them work on it themselves
  - **Autonomy**: Allow students to select their activity topic
- Online interactive learning:
  - **Autonomy**: Control over content, learning pace, and learning activities
  - **Learning Experience**: Positive experience based on CoI's three presences.

Future work seeks to implement these active learning design principles in other courses beyond chemistry and science.