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The Impact of Using an Online Collaborative Platform in Blended Learning on Postsecondary Vocational School Year One Students' Self-Regulated Learning Abilities: A Quasi-Experimental Research

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Abstract: Self-regulated learning (SRL) abilities refer to learners' abilities to achieve their individual learning goals in the continuous learning process. While previous research has demonstrated the positive impact of SRL abilities on learning outcomes, there is a lack of exploration regarding the use of online collaborative whiteboards as regulating scaffolds (e.g., organizational structure for learning or tasks, tools for communication and knowledge co-construction, and timely feedback) for affecting students' SRL abilities in blended learning contexts. Therefore, 141 students participated in this quasi-experimental study to evaluate the influence of blended learning through BoardMix, an online collaborative whiteboard platform, on the SRL abilities of year one students in a Chinese postsecondary vocational school. During a four-week learning, with the pedagogical approach based on Zimmerman's cyclical model of SRL, students in the experimental group used the BoardMix platform to collaborate with each other. The Online Self-Regulated Learning Questionnaire (OLSQ) (Barnard et al., 2009) was used to collect quantitative data in pre-tests and post-tests for both experimental and control groups, and ANCOVA was adopted to analyze the data. The ANCOVA results revealed significant improvements in SRL abilities and significant differences between the experimental and control groups. Collaborating through the online platform BoardMix significantly enhanced the SRL abilities of the experimental group. In the second phase of this research project, qualitative research was adopted to provide deeper insights into the influence of online whiteboards on learners' SRL abilities, and future applications of collaborative learning can be explored based on these findings which will be presented in another paper.

Keywords: Online collaborative platform, self-regulated learning abilities, blended learning environment

1. Introduction

Grounded in socio-cognitive theory, self-regulated learning (SRL) abilities refer to learners' abilities to achieve their individual learning goals through different regulation and control (behavioral, cognitive, metacognitive, motivational, and emotional) in the SRL process (Ateş Akdeniz, 2023; Lin, 2019; Panadero, 2017; Zhu et al., 2016). Previous studies have shown a positive impact of SRL abilities on learners' learning performance in regular classrooms, blended learning contexts, and online learning environments (Barnard et al., 2009; Lin, 2019; Zhu et al., 2016). However, for those in blended and online learning contexts, most studies explored the SRL process from the perspective of individual students without considering social interactions (Lin, 2018). While SRL is an internal process, it is influenced by social interaction (Järvelä & Hadwin, 2013; Panadero & Järvelä, 2015). As the importance of shared knowledge construction and collaboration in the SRL process is gaining increasing

attention (Hadwin et al., 2017), the influence of collaboration on students' SRL abilities needs further exploration.

Online collaborative platforms refer to web-based tools that enable multiple users to collaborate and work together on shared documents, projects, or tasks. These platforms provide a virtual workspace where users can create, edit, and comment on content simultaneously, allowing for real-time collaboration regardless of geographical location (Chu & Kennedy, 2011). Collaboration benefits students' engagement and problem-solving in blended learning, and SRL is one of the key elements of the effectiveness of collaborative blended learning (Zhao & Cao, 2023). Among various online collaborative platforms, organizing students to learn and collaborate in online whiteboards has become increasingly popular recently as such platforms are generally user-friendly and allow for both synchronous and asynchronous collaboration. Online whiteboards provide an interactive space that facilitates collaborative knowledge construction (Alvarez et al., 2013). However, there is a lack of exploration of using online whiteboards in frontline collaborative learning for students in China. This study aims to address this gap by focusing on whether online collaborative whiteboards can effectively influence students' SRL abilities by serving as regulating scaffolds for group activities in a blended learning context.

Therefore, this study is guided by the following research question: *Does the use of an online collaborative platform in blended learning influence year one students' self-regulated learning (SRL) abilities in a Chinese postsecondary vocational school?*

2. Literature review

2.1 Theoretical framework of self-regulated learning

The social cognitive perspective of self-regulated learning involves a comprehensive analysis of the various processes involved and recognizes the reciprocal relationship between personal, behavioral, and environmental factors on learning outcomes (Barnard et al., 2010; Zimmerman, 1986, 1989). SRL abilities can be developed in these processes and they appear to be cyclical (Barnard et al., 2010; Panadero, 2017). Previous research has generated multiple theoretical models that describe self-regulated learning phases (Alhazbi & Hasan, 2021; Panadero, 2017). Among them, Zimmerman's SRL model exemplifies a unique approach that combines both process and component-oriented classifications within a single framework, and it is regarded as more frequently cited in the literature (Ateş Akdeniz, 2023). Zimmerman's cyclical model has been used in intervention design for self-regulated learning and instrument development (Alhazbi & Hasan, 2021; Ateş Akdeniz, 2023; Panadero, 2017).

Zimmerman's cyclical model includes three phases: the forethought phase, the performance phase, and the self-reflection phase (Zimmerman & Moylan, 2009). In the forethought phase, learners first analyze the task at hand and plan the optimal strategies for success. Secondly, they assess their self-motivational beliefs, including self-efficacy, outcome expectations, intrinsic interest, task value, and goals (Winne & Hadwin, 2010). This phase influences students' preparation and willingness to self-regulate (Zimmerman & Moylan, 2009). During the performance phase, learners actively engage in learning tasks and apply control processes to maintain focus and progress toward their goals. Learners engage in self-control (e.g., self-instruction, mental imaging, attention focusing, and applying strategies to manage complex tasks) and self-observation (recording and evaluating their actions and experimenting with variations to improve their approach) (Winne & Hadwin, 2010). In the self-reflection phase, learners assess the extent to which they have achieved their goals, and compare their achievements against various standards, including mastery, their prior performance, normative expectations, and, in collaborative tasks, whether their expectations were successfully met (Winne & Hadwin, 2010). This phase influences learners' reactions to their learning experiences and shapes their forethought for subsequent learning efforts, completing the self-regulatory cycle (Zimmerman & Moylan, 2009). Considering its maturity, this model was selected to guide the design of the pedagogy of intervention in this study.

Figure 1 indicates the three SRL phases and dimensions of SRL abilities that are focused on in this study. These phases align with the three phases of Zimmerman's cyclical

model (Alhazbi & Hasan, 2021; Zimmerman & Moylan, 2009). A learner who possesses self-regulation initiates learning activities by establishing clear learning goals and devising a well-structured plan that outlines the necessary strategies and time allocation. Throughout the learning process, the learner takes deliberate steps to optimize their learning environment, task strategies, time management, and ways of seeking help or assistance from peers and teachers. Finally, the learner engages in self-evaluation, reflecting on their progress and adapting their strategies accordingly to enhance future learning experiences (Alhazbi & Hasan, 2021). Consistent with the adopted pedagogy, Barnard et al. (2009)'s instrument with six dimensions (goal setting, environment structuring, task strategies, time management, help seeking, and self-evaluation) was adopted as pretests and posttests in this study.

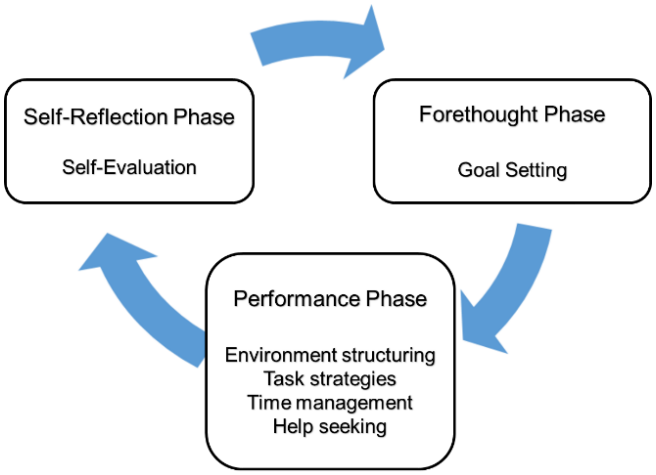

Figure 1. The three SRL phases and dimensions of SRL abilities.

2.2 Research gap

First, research on the impact of collaboration on SRL abilities in blended and online learning is limited. Previous studies mainly focused more on using self-regulated learning abilities as independent variables to predict other learning variables. For example, Lin et al. (2023) found that online SRL could predict adult learners' perceived satisfaction with online learning. Alhazbi & Hasan (2021) found the relationship between students' SRL abilities and their academic achievements. While revealing the importance of SRL, these studies explored the SRL abilities in the context of independent learning, such as designing an SRL learning process that lacks peer interaction (Lin, 2018). From the social cognitive perspective, the development of SRL abilities is influenced by the combined effects of personal, behavioral, and environmental factors (Barnard et al., 2010; Panadero & Järvelä, 2015; Zimmerman, 1986, 1989). Whether peer collaboration influences students' SRL abilities in blended learning environments needs further exploration.

Second, there is insufficient exploration of the impact of web-based collaborative platforms on students' SRL abilities, especially for online whiteboards. Previous studies focused more on exploring the influence of web-based collaborative platforms on collaborative learning outcomes (Chu & Kennedy, 2011; Silvia & Iryna, 2012). Among the web-based collaborative platforms, learning management systems (LMS) (Zhao & Cao, 2023), wiki (such as MediaWiki and Google Docs) (Chu & Kennedy, 2011; Silvia & Iryna, 2012), and online whiteboards (Zheng et al., 2023) have been used in previous studies. However, compared to LMS and wiki, online whiteboards are less commonly utilized though such kind of platforms give it the potential to develop students' SRL abilities. Collaborative learning using online whiteboards was not widely adopted among students in China. For example, Li et al. (2021) investigated the impact of an online whiteboard (Miro) on students' collaborative behaviors, and found that the online whiteboard benefited problem identification, idea construction, and solution evaluation through effective visual interaction. However, their study was conducted in an online workshop held by a Chinese university for students from different countries, and did not apply online whiteboards in real Chinese classroom settings. Huang (2020) provided

frontline experiences but the online whiteboard only served as a writing and drawing platform for teachers to clarify knowledge and ideas, and the effect of using online whiteboards for students was not examined. Further frontline investigation is necessary to explore the impact of online collaborative whiteboards in enhancing students' SRL abilities as regulatory scaffolds for group activities within the context of blended learning.

3. Methodology

3.1 Procedures, ethical concerns, and research design

This study was carried out at a postsecondary vocational school in southwest China. Year one postsecondary vocational school students are required to take general education courses (Yan & Zhang, 2024). This study was implemented in one of the general education courses in which learners engaged in group collaboration to select group topics, regulate the learning process, and evaluate the learning performance of peers and themselves in ill-structured learning tasks. Besides, this course was conducted in blended learning environments, where students learned through classroom lectures, online resources and quizzes, and extracurricular activities. Before implementing this study, consent was obtained from the participating students, the teachers, and the head of the school. The ethics application was approved by the faculty before sending these consents.

Following the quasi-experimental design (Cohen, 2000), as shown in Figure 2, this study investigated the impact of the online collaborative platform through blended learning on Chinese postsecondary vocational school year one nurse students' self-regulated learning (SRL) abilities. 141 Chinese postsecondary vocational school year one nurse students and three teachers were invited to this study. To understand students' SRL abilities before and after the learning process, students from both the experiment group (n=78) and the control group (n=63) conducted SRL pre-tests four days before the four-week collaborative learning process, and completed SRL post-tests one day after that. During the four-week learning process, the experiment group was invited to use BoardMix, an online collaborative platform, to organize their group collaboration, while the control groups used the traditional form of collaboration to complete group tasks. Based on the work of Alhazbi & Hasan (2021) and Ateş Akdeniz (2023), the SRL learning process was adopted to design the four-week group collaboration activities for the experimental group when learning with BoardMix.

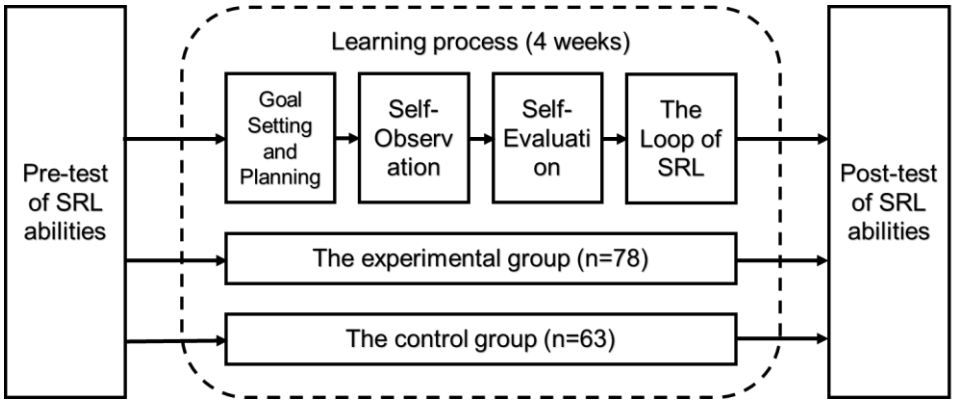

Figure 2. The research design and learning process.

3.2 Intervention

3.2.1 Pedagogy

Zimmerman's cyclical model is a process model that guided the design of the pedagogical approach in this study (Winne & Hadwin, 2010). It can be combined with scaffoldings (e.g., organizational structure for learning or tasks, tools for communication and knowledge co-construction, and timely feedback) using collaborative platforms (Ateş Akdeniz,

2023). When implementing this model to self-regulated learning, a social, environmental, and personal feedback loop is shaped to provide information for subsequent adaptations (Zimmerman & Moylan, 2009). The pedagogical approach was developed according to the SRL phases and intervention process developed by Ateş Akdeniz (2023). Figure 3 shows the learning process with scaffoldings based on Zimmerman's cyclical model.

Following the same scaffolding of the SRL learning process, students in both experimental groups and control groups set their goals and implementing plan in the first week, discussed and reflected on their previous learning process in the second week, evaluated groups' procedure and performance in the third week, and presented collaboration products and reflected individual performance in the fourth week.

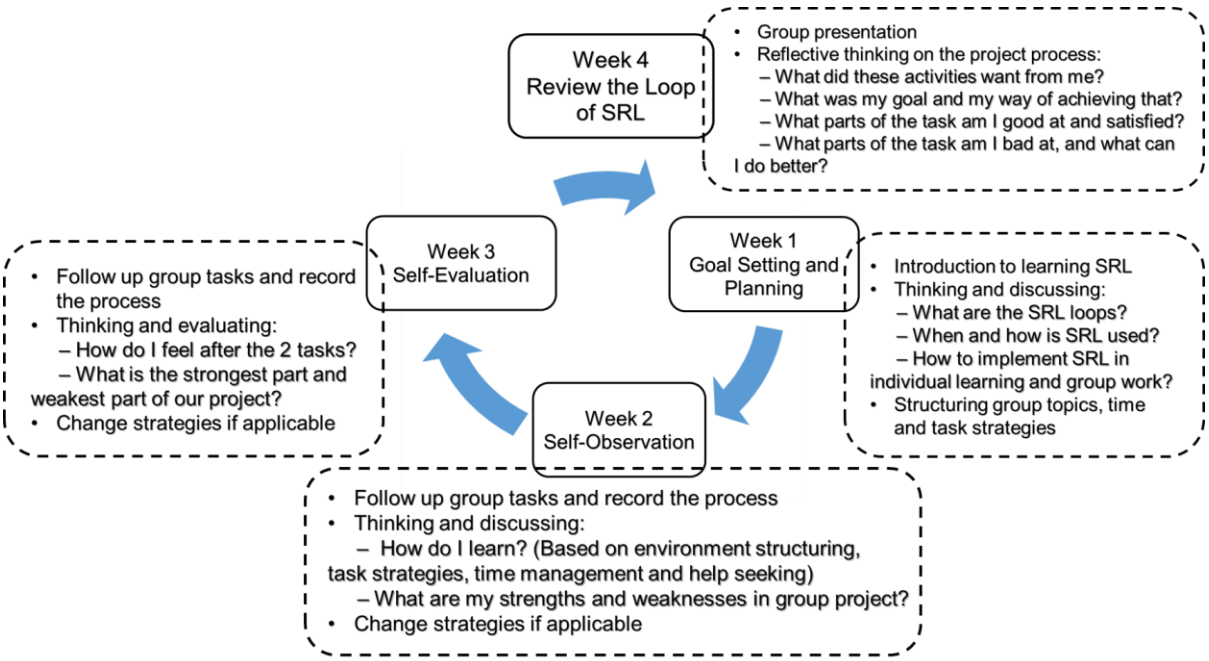

Figure 3. The learning process with scaffoldings based on Zimmerman's cyclical model.

3.2.2 The Adopted Online Collaborative Platform

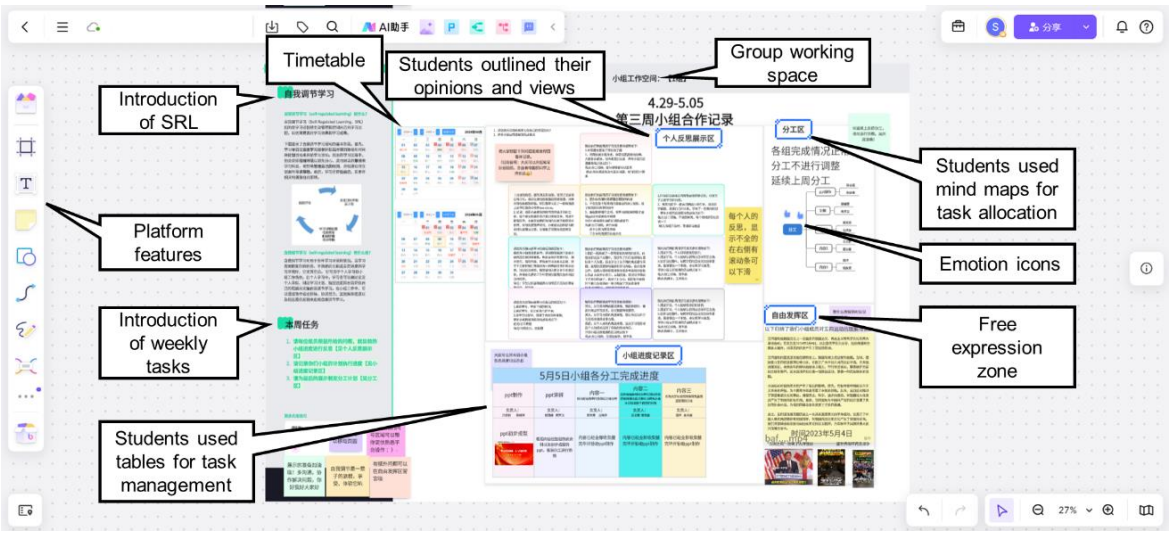

Figure 4. The sample of learning activities on the Boardmix platform.

BoardMix (https://boardmix.cn/) is an online whiteboard that allows users to upload rich resources (e.g., text, pictures, documents, video, etc.) and offers various features (e.g., mind mapping tools, emotion icons, stickers, flowcharts, etc.) to promote peer collaboration (Zheng et al., 2023). Figure 4 presents a sample of students' learning activities in the third week and

the user interface of the Boardmix platform. Due to the default setting of the BoardMix as a blank canvas, the reflective questions were placed on the whiteboard to provide support for the experimental group students, while the control group students received these presented in a Word document. Both groups of students followed the same pedagogical approach and adhered to the same final product requirements. Each class had two sessions per week. During the first session of each week, the teacher introduced the platform information and announced the requirements for the weekly tasks. Students had one week to complete the tasks and used the aforementioned functions to set goals and structure implementation methods collaboratively. For example, they engaged in online conversations or offline group discussions and simultaneously utilized features like mind mapping tools to brainstorm and construct content. In the first session of the following week, the teacher provided feedback on the previous week's outcomes and showcased the platform achievements of each group before assigning new tasks.

3.3 Research instruments

The literature review found that self-report tools were effective in measuring learners' self-regulated learning (SRL) abilities. However, it is important to note that some questionnaire tools are designed for use in face-to-face classroom environments and may not be suitable for blended or online learning settings. Thus, Barnard et al. (2009) considered it in this study. The Online Self-Regulated Learning Questionnaire (OLSQ) was used for the pre-tests and post-tests to collect quantitative data (Barnard et al., 2009). This instrument has good reliability and validity (Barnard et al., 2009; Zhao & Cao, 2023). A 5-point Likert-type response format was utilized, with values ranging from 1 (strongly disagree) to 5 (strongly agree). Aligning with Zimmerman's cyclical model, the QLSQ includes six dimensions: goal setting (GS), environment structuring (ES), task strategies (TS), time management (TM), help seeking (HS), and self-evaluation (SE).

3.4 Data analysis

Before conducting the intervention, the independent samples t-test was carried out to check if there were any significant differences between the experimental group and the control group regarding students' pre-test results about self-regulated learning abilities. Cronbach's alpha was also calculated to ensure the reliability of the instrument. After finishing these, descriptive statistics were conducted to an overview of participant demographics and students' SRL abilities before and after the intervention. One-way between-groups analyses of covariance (ANCOVA) were also conducted for all pretest and post-test scores. Compared to the analysis of variance (ANOVA), ANCOVA mitigates the initial differences between experimental and control groups by setting the pre-test differences as covariates, and thus the results are more accurate (Liu et al., 2022). In this study, the experimental and control group's pre-test differences in SRL abilities are regarded as covariates. The above analyses were conducted using IBM SPSS 26.0.

4. Results and findings

4.1 Reliability and the independent samples t-test

Results of Cronbach's alpha from pre-tests revealed excellent internal consistency of the whole instrument (α = 0.977) and each dimension (αGS = 0.929, αES = 0.884, αTS = 0.912, αTM = 0.892, αHS = 0.923, αSE = 0.945), because all these Cronbach's alpha values were greater than 0.7. Results of Levene's test supported the equality of variances of the whole instrument (F = 0.03, p = 0.86 > 0.05) and each dimension (F_{GS} = 0.03, P_{GS} = 0.92 > 0.05; F_{ES} = 1.03, P_{ES} = 0.31 > 0.05; F_{TS} = 1.40, P_{TS} = 0.24 > 0.05; F_{TM} = 0.04, P_{TM} = 0.95 > 0.05; F_{HS} = 0.59, P_{HS} = 0.44 > 0.05; F_{SE} = 0.22, P_{SE} = 0.64 > 0.05). Thus, the assumption of the independent samples t-test was met. As shown in Table 1, the results of the independent

samples t-test indicated there were no significant differences between the experimental group and control group in terms of SRL abilities before conducting the treatment. This meant that the two groups had similar levels before implementing the intervention.

Table 1. *Independent samples t-test results for the experimental and control group*

	T	DF	Sig.	Mean Difference	Std. Error Difference
SRL abilities (Overall)	0.38	139	0.70	0.92	2.42
Goal Setting	0.34	139	0.74	0.04	0.11
Environment Structuring	0.21	139	0.83	0.02	0.11
Task Strategies	0.62	139	0.54	0.07	0.12
Time Management	0.32	139	0.75	0.04	0.12
Help Seeking	0.29	139	0.77	0.03	0.11
Self-Evaluation	0.27	139	0.79	0.03	0.11

4.2 Descriptive statistics

Table 2. *Descriptive statistics results for the pre-test and post-test of the SRL abilities*

Dimensions of SRL abilities	Groups	N	Time	Mean	Std. Deviation	Minimum	Maximum
SRL abilities (Overall)	Experimental group	78	pre-test	94.65	14.05	65	120
			post-test	103.78	15.30	72	120
	Control group	63	pre-test	93.73	14.51	72	120
			post-test	97.68	12.71	72	120
Goal Setting	Experimental group	78	pre-test	3.99	0.65	2.60	5.00
			post-test	4.29	0.71	3.00	5.00
	Control group	63	pre-test	4.06	0.63	3.00	5.00
			post-test	3.90	0.58	2.80	5.00
Environment Structuring	Experimental group	78	pre-test	4.07	0.64	2.75	5.00
			post-test	4.49	0.58	3.00	5.00
	Control group	63	pre-test	4.18	0.61	3.00	5.00
			post-test	4.09	0.54	3.00	5.00
Task Strategies	Experimental group	78	pre-test	3.82	0.67	2.50	5.00
			post-test	4.26	0.72	3.00	5.00
	Control group	63	pre-test	3.89	0.78	2.25	5.00
			post-test	3.87	0.63	2.75	5.00
Time Management	Experimental group	78	pre-test	3.84	0.70	2.00	5.00
			post-test	4.27	0.74	2.67	5.00
	Control group	63	pre-test	3.94	0.73	2.67	5.00
			post-test	3.87	0.62	2.67	5.00
Help Seeking	Experimental group	78	pre-test	3.95	0.62	2.75	5.00
			post-test	4.33	0.67	3.00	5.00
	Control group	63	pre-test	4.05	0.67	3.00	5.00
			post-test	3.94	0.55	2.50	5.00
Self-Evaluation	Experimental group	78	pre-test	3.94	0.63	3.00	5.00
			post-test	4.30	0.69	3.00	5.00
	Control group	63	pre-test	4.02	0.69	2.75	5.00
			post-test	3.99	0.54	2.75	5.00

In the beginning, 162 Chinese postsecondary vocational school year one nurse students from two classes taught by the same teacher participated in this study. After the intervention, there were 141 students (87.04%) completed both pre-tests and post-tests, with 78 students in the experimental group and 63 students in the control group. These groups had a similar gender ratio (65 and 52 female students respectively) and the same age range from 18 to 21 years old. The two groups' SRL abilities were explored through the Online Self-Regulated Learning Questionnaire (OLSQ) both before and after the group collaboration to check if students' SRL abilities improved after the learning process. Table 2 shows the descriptive statistics for the pre-test and post-test of the SRL abilities. These results showed a slight difference in means between groups.

4.3 Analyses of covariance (ANCOVA) for SRL abilities

One-way between-groups ANCOVA was run to check if there were any significant improvements in SRL abilities and any significant differences between the experimental group and control group. The results are presented in Table 3.

Table 3. *ANCOVA for SRL abilities*

Dimensions of SRL abilities	Type III Sum of Squares	DF	Mean Square	F	Sig.	Partial Eta Squared
SRL abilities (overall)	1111.44	1	1111.44	7.19	0.01	0.05
Goal Setting	2.54	1	2.54	6.63	0.01	0.05
Environment Structuring	2.36	1	2.36	8.54	0.00	0.06
Task Strategies	1.48	1	1.48	3.95	0.05	0.03
Time Management	2.13	1	2.13	5.25	0.02	0.04
Help Seeking	2.13	1	2.13	7.06	0.01	0.05
Self-Evaluation	1.22	1	1.22	4.07	0.05	0.03

The results suggested that these two groups showed significant differences in all dimensions involved and overall SRL abilities between the pre-test and post-test. Therefore, it was possible to conclude that using the online collaborative platform significantly improved the SRL abilities of the experimental group of year one nurse students in a Chinese postsecondary vocational school.

5. Discussion and conclusion

Goal setting, environment structuring, task strategies, time management, help seeking, and self-evaluation are six elements that are included in Zimmerman's cyclical model of self-regulated learning (Zimmerman & Moylan, 2009). These elements are the abilities of SRL and dynamic regulating strategies in the learning process (Lin et al., 2023). In this study, collaborating using the online whiteboard (BoardMix) was found helpful for developing year one students' SRL abilities in a postsecondary vocational school in the overall figure and each of the six dimensions. These findings aligned with some studies that used collaboration in developing learners' SRL abilities (Järvelä et al., 2016; Lajoie et al., 2015). The improvement of "goal setting" and "help seeking" is consistent with the findings of Alhazbi & Hasan (2021) using the same instrument. However, this study further implemented a SRL process in developing students' SRL abilities. To develop students' SRL abilities, Lajoie et al. (2015) used a combination of tools that included video-conferencing, chat boxes, and a shared whiteboard to support medical students' collaborative engagement by facilitating peer online discussion in a synchronous computer-supported collaborative learning environment. This study was in line with Lajoie et al.'s (2015) work by using an advanced whiteboard platform and further explored integrating SRL scaffoldings to the online whiteboards in group collaboration.

There were several limitations to this study. Firstly, although we considered the influence of time on students' SRL abilities, we only had quantitative data from two-time points, namely the pre-test and post-test. Future research could further investigate the impact of collaboration using online platforms on students' SRL abilities by conducting longitudinal trials and tracking students' SRL abilities over time or capturing process data during student collaboration. Secondly, all the participating students were majoring in nursing and predominantly female, which to some extent may impact the generalizability of this study. Future research can consider inviting participants from more diverse backgrounds. Thirdly, this study has not fully explored all the components of Zimmerman's cyclical model of self-regulated learning. Future research could consider incorporating additional dimensions of this model and integrating other motivational and behavioral factors to assess SRL abilities. Moreover, utilizing diverse data sources to support triangulation, such as teacher and student interviews, would provide a more comprehensive perspective for this study.

In conclusion, this study showed that the use of an online collaborative platform (using online whiteboards as an example) could improve the SRL abilities of year one nurse students in Chinese postsecondary vocational schools, compared to those not using the online collaborative platform. Further insight into how the online whiteboard influences learners' SRL abilities was explored using the data of qualitative research in the second stage of this research project. After that, implications for future application of collaborative learning can be proposed and all these will be presented in a forthcoming paper.

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References

Alhazbi, S., & Hasan, M. A. (2021). The role of self-regulation in remote emergency learning: Comparing synchronous and asynchronous online Learning. *Sustainability*, *13*(19), 11070. https://doi.org/10.3390/su131911070

Alvarez, C., Salavati, S., Nussbaum, M., & Milrad, M. (2013). Collboard: Fostering new media literacies in the classroom through collaborative problem solving supported by digital pens and interactive whiteboards. *Computers & Education*, *63*, 368–379. https://doi.org/10.1016/j.compedu.2012.12.019

Ateş Akdeniz, A. (2023). Exploring the impact of self-regulated learning intervention on students' strategy use and performance in a design studio course. *International Journal of Technology and Design Education*, *33*(5), 1923–1957. https://doi.org/10.1007/s10798-022-09798-3

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. https://doi.org/10.1016/j.iheduc.2008.10.005

Barnard, L., Paton, V. O., & Lan, W. Y. (2010). Profiles in self-regulated learning in the online learning environment. *The International Review of Research in Open and Distributed Learning*, *11*(1), 61. https://doi.org/10.19173/irrodl.v11i1.769

Chu, S., & Kennedy, D. M. (2011). Using online collaborative tools for groups to co-construct knowledge. *Online Information Review*, *35*(4), 581–597. https://doi.org/10.1108/14684521111161945

Cohen, L., Manion, L. & Morrison, K. (2000). Research methods in education. Routledge Falmer. http://dx.doi.org/10.4324/9780203224342

Hadwin, A., Järvelä, S., & Miller, M. (2017). Self-regulation, co-regulation, and shared regulation in collaborative learning environments. In *Handbook of self-regulation of learning and performance* (pp. 83–106). Routledge.

Huang, J. (2020). Successes and challenges: Online teaching and learning of chemistry in higher education in China in the time of COVID-19. *Journal of Chemical Education*, *97*(9), 2810–2814. https://doi.org/10.1021/acs.jchemed.0c00671

Järvelä, S., & Hadwin, A. F. (2013). New Frontiers: Regulating learning in CSCL. *Educational Psychologist*, *48*(1), 25–39. https://doi.org/10.1080/00461520.2012.748006

Järvelä, S., Järvenoja, H., Malmberg, J., Isohätälä, J., & Sobocinski, M. (2016). How do types of interaction and phases of self-regulated learning set a stage for collaborative engagement? *Learning and Instruction*, *43*, 39–51. https://doi.org/10.1016/j.learninstruc.2016.01.005

Lajoie, S. P., Lee, L., Poitras, E., Bassiri, M., Kazemitabar, M., Cruz-Panesso, I., Hmelo-Silver, C., Wiseman, J., Chan, L. K., & Lu, J. (2015). The role of regulation in medical student learning in small groups: Regulating oneself and others' learning and emotions. *Computers in Human Behavior*, *52*, 601–616. https://doi.org/10.1016/j.chb.2014.11.073

Li, Q., Zhang, J., Xie, X., & Luximon, Y. (2021). How shared online whiteboard supports online collaborative design activities: A social interaction perspective. In E. Markopoulos, R. S. Goonetilleke, A. G. Ho, & Y. Luximon (Eds.), *Advances in Creativity, Innovation, Entrepreneurship and Communication of Design* (Vol. 276, pp. 285–293). Springer International Publishing. https://doi.org/10.1007/978-3-030-80094-9_34

Lin, F., Lim, L., Ho, Y. Y., Tan, B. Z., & Lim, W. Y. (2023). Validating and applying an adapted OSLQ to examine adult learners' online self-regulation. *Higher Education Research & Development*, *42*(7), 1684–1699. https://doi.org/10.1080/07294360.2023.2183938

Lin, J. (2019). The impact of team-based learning on students with different self-regulated learning abilities. *Journal of Computer Assisted Learning*, *35*(6), 758–768. https://doi.org/10.1111/jcal.12382

Lin, J.-W. (2018). Effects of an online team project-based learning environment with group awareness and peer evaluation on socially shared regulation of learning and self-regulated learning. *Behaviour & Information Technology*, *37*(5), 445–461. https://doi.org/10.1080/0144929X.2018.1451558

Liu, G., Rahimi, M., & Fathi, J. (2022). Flipping writing metacognitive strategies and writing skills in an English as a foreign language collaborative writing context: A mixed-methods study. *Journal of Computer Assisted Learning*, *38*(6), 1730–1751. https://doi.org/10.1111/jcal.12707

Panadero, E. (2017). A review of self-regulated learning: Six models and four directions for research. *Frontiers in Psychology*, *8*, 422. https://doi.org/10.3389/fpsyg.2017.00422

Panadero, E., & Järvelä, S. (2015). Socially shared regulation of learning: A review. *European Psychologist*, *20*(3), 190–203. https://doi.org/10.1027/1016-9040/a000226

Silvia, R.-D., & Iryna, B. (2012). The influence of online communication and web-based collaboration environments on group collaboration and performance. *Procedia - Social and Behavioral Sciences*, *46*, 935–943. https://doi.org/10.1016/j.sbspro.2012.05.227

Winne, P. H., & Hadwin, A. F. (2010). Self-regulated learning and socio-cognitive theory. In *International Encyclopedia of Education* (pp. 503–508). Elsevier. https://doi.org/10.1016/B978-0-08-044894-7.00470-X

Yan, K., & Zhang, Y. (2024). The tensions of general education reform in China. *Asia Pacific Education Review*, *25*(1), 131–142. https://doi.org/10.1007/s12564-022-09767-4

Zhao, S., & Cao, C. (2023). Exploring relationship among self-regulated learning, self-efficacy and engagement in blended collaborative context. *SAGE Open*, *13*(1), 215824402311572. https://doi.org/10.1177/21582440231157240

Zheng, X.-L., Huang, J., Xia, X.-H., Hwang, G.-J., Tu, Y.-F., Huang, Y.-P., & Wang, F. (2023). Effects of online whiteboard-based collaborative argumentation scaffolds on group-level cognitive regulations, written argument skills and regulation patterns. *Computers & Education*, *207*, 104920. https://doi.org/10.1016/j.compedu.2023.104920

Zhu, Y., Au, W., & Yates, G. (2016). University students' self-control and self-regulated learning in a blended course. *The Internet and Higher Education*, *30*, 54–62. https://doi.org/10.1016/j.iheduc.2016.04.001

Zimmerman, B. J. (1986). Becoming a self-regulated learner: Which are the key subprocesses? *Contemporary Educational Psychology*, *11*(4), 307–313. https://doi.org/10.1016/0361-476X(86)90027-5

Zimmerman, B. J. (1989). A social cognitive view of self-regulated academic learning. *Journal of Educational Psychology*, *83*(3), 329–339. https://doi.org/10.1037/0022-0663.81.3.329

Zimmerman, B. J., & Moylan, A. R. (Eds.). (2009). Self-regulation: Where metacognition and motivation intersect. In *Handbook of metacognition in education* (pp. 299–315). Routledge.