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An Experimental Study on the Impact of Collaborative and Active Learning on Vocational Students' Learning Achievement and Self-Motivation

Estudio experimental sobre el impacto del aprendizaje colaborativo y activo en el rendimiento académico y la automotivación de los estudiantes de formación profesional

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Abstract

The study examines a blended instructional approach combining collaborative and active learning to improve vocational students' learning achievement and self-motivation. An experimental design was utilized, dividing vocational students into control and experiment groups. The experiment group participated in a one-month collaborative and active learning intervention, while the control group received traditional instruction. The experiment group achieved significant gains in academic achievement, with pre-test and post-test means rising from 79.63 to 86.15 ($t=19.72$, $p<0.05$) and self-motivation scores increasing from 37.82 to 42.74 ($t=19.71$, $p<0.05$). In contrast, the control group exhibited lower post-test scores in both academic achievement (mean=80.16, $t=3.67$, $p<0.05$) and self-motivation (mean=38.4, $t=5.31$, $p<0.05$). These results indicate that integrating collaborative and active learning strategies significantly impacts learning achievement and self-motivation in vocational education. This suggests that this instructional approach is highly effective in improving student outcomes.

Keywords: Instructional Approach; Collaborative Learning; Active Learning; Learning Achievement; Self-Motivation

Resumen

El estudio examina un enfoque de enseñanza combinado que integra el aprendizaje colaborativo y activo para mejorar el rendimiento académico y la automotivación de los estudiantes de formación profesional. Se utilizó un diseño experimental, dividiendo a los estudiantes de formación profesional en grupos de control y experimental. El grupo experimental participó en una intervención de aprendizaje colaborativo y activo durante un mes, mientras que el grupo de control recibió instrucción tradicional. El grupo experimental logró aumentos significativos en el rendimiento académico, con medias de pretest y postest que aumentaron de 79.63 a 86.15 ($t=19.72$, $p<0.05$), y en las puntuaciones de automotivación, que incrementaron de 37.82 a 42.74 ($t=19.71$, $p<0.05$). En contraste, el grupo de control mostró puntuaciones más bajas en el postest tanto en rendimiento académico (media=80.16, $t=3.67$, $p<0.05$) como en automotivación (media=38.4, $t=5.31$, $p<0.05$). Estos resultados indican que la integración de estrategias de aprendizaje colaborativo y activo tiene un impacto significativo en el rendimiento académico y la automotivación en la educación profesional, sugiriendo que este enfoque de enseñanza es altamente efectivo para mejorar los resultados de los estudiantes.

Palabras clave: Enfoque de enseñanza; Aprendizaje colaborativo; Aprendizaje activo; Rendimiento académico; Automotivación.

Resumo

O estudo examina uma abordagem de ensino combinada que integra a aprendizagem colaborativa e ativa para melhorar o desempenho acadêmico e a automotivação dos estudantes de formação profissional. Foi utilizado um desenho experimental, dividindo os estudantes de formação profissional em grupos de controle e experimental. O grupo experimental participou de uma intervenção de aprendizagem colaborativa e ativa durante um mês, enquanto o grupo de controle recebeu instrução tradicional. O grupo experimental alcançou aumentos significativos no desempenho acadêmico, com médias de pré-teste e pós-teste que aumentaram de 79,63 para 86,15 ($t=19,72$, $p<0,05$), e nas pontuações de automotivação, que aumentaram de 37,82 para 42,74 ($t=19,71$, $p<0,05$). Em contraste, o grupo de controle apresentou pontuações mais baixas no pós-teste, tanto no desempenho acadêmico (média=80,16, $t=3,67$, $p<0,05$) quanto na automotivação (média=38,4, $t=5,31$, $p<0,05$). Esses resultados indicam que a integração de estratégias de aprendizagem colaborativa e ativa tem um impacto significativo no desempenho acadêmico e na automotivação na educação profissional, sugerindo que essa abordagem de ensino é altamente eficaz para melhorar os resultados dos estudantes.

Palavras-chave: Abordagem de ensino; Aprendizagem colaborativa; Aprendizagem ativa; Desempenho acadêmico; Automotivação

Introduction

Traditional education has long been the dominant model in teaching professions. The teacher-centered approach focuses on knowledge transmission and standardized learning (Ribeiro, 2011). Bonwell and Eison (1991) criticized traditional, lecture-based instruction for limiting student participation and adopting a one-way transfer of information. While this method effectively transmits large amounts of information, more is needed to foster deeper understanding and critical thinking (Regmi, 2012). Despite its conventional use, traditional education has inherent limitations. Expecting students to learn uniformly can result in disengagement or aversion to education (Cole et al., 2004). This has prompted a shift toward innovative, student-centered approaches to address these issues.

Collaborative learning and active learning represent innovative teaching methods successfully applied in vocational education for decades (Győri & Czakó, 2020). These methods enhance students' teamwork skills and foster independent thinking and problem-solving abilities. Collaborative learning involves students working together to complete tasks, discuss problems, and find solutions, helping them develop communication, coordination, and cooperation skills. It fosters a sense of teamwork and collective responsibility, enabling students to support each other when facing complex practical tasks (Haugland et al., 2022; Coll et al., 2014). Active learning requires students to engage actively in courses, explore knowledge independently, pose questions, and seek solutions. This approach cultivates autonomous learning, fostering independent thinking and problem-solving and enhancing motivation and achievement (Paulins & Moeller, 2017; Freeman et al., 2014). In the 21st-century vocational environment, these abilities are considered essential skills. Therefore, applying collaborative and active learning methods in vocational education is crucial.

Previous research has theoretically supported integrating collaborative and active learning methods in vocational education, indicating that these approaches can enhance students' learning achievement and self-motivation (Ruijuan et al., 2023). Despite the broad theoretical acceptance of blended teaching methods, their practical application in vocational education has yet to be fully validated. Research on the impact of these methods on student achievement and motivation remains limited in Chinese vocational education. For instance, a Collaborative Learning by Teaching experiment conducted at a Chinese university was positively received by students (Zhou et al., 2019). Chinese education authorities have increasingly encouraged veteran teachers to incorporate collaborative learning methods, including classroom action research and joint lesson planning (Qi et al., 2021). A meta-analysis found that in STEM (science, technology, engineering, and mathematics) education in China, active learning improved students' academic performance, engagement, and classroom satisfaction compared to traditional teaching methods (Ting et al., 2023).

Hence, this study aims to investigate the implementation of blended teaching methods and their impact on students' learning achievement and self-motivation in vocational education. Specifically, it seeks to answer two core questions: 1) Can blended teaching methods significantly improve vocational students' learning achievement and self-motivation? 2) Do blended teaching methods offer a clear advantage over traditional approaches in vocational education? The findings will provide theoretical insights for improving teaching methods in vocational education and practical guidance for educational practice.

This study is grounded in the theory that collaborative and active learning, though well-developed in general education, has yet to be widely explored in vocational education. However, new insights and approaches tailored to vocational students are now available. From a practical standpoint, this research will develop blended teaching strategies that integrate collaborative and active learning to address practical challenges in vocational skills education. These strategies will help improve teaching quality and the vocational skills development of students. Additionally, this study contributes to the theoretical discourse on vocational education by providing evidence for educational reforms, thereby promoting the holistic development of vocational students within the specific educational environment of vocational training.

Literature Review

Importance of Learning Achievement and Self-Motivation

The importance of learning achievement and self-motivation is well-documented in educational research. Wild and Grassinger (2023) found that difficulties in self-regulating personal motivation are linked to higher dropout rates in university courses, with students who struggle in self-regulation more prone to dropping out. Achievement motivation, including academic self-concept and interest in the subject, directly influences academic performance, with students possessing higher motivation typically performing better (Susanto & Bahar, 2020; Ghorbani Yekta et al., 2020). Perceived teaching quality indirectly impacts dropout rates through its effect on academic self-concept, subject interest, and motivation regulation. High-quality teaching can increase student enthusiasm and retention (Wild & Grassinger, 2023). Alrashidi (2020) suggests that strategies such as detailed feedback, group work, and multimedia can enhance motivational constructs (e.g., self-efficacy) and improve language achievement. Envisioning oneself as a proficient language user (Ideal et al.) is closely tied to learning achievement and is a crucial motivator (Tort Calvo, 2015).

What is Collaborative Learning?

Collaborative learning promotes cooperation and active group participation, enhancing outcomes through interaction, idea-sharing, and mutual support. Grounded in Vygotsky's sociocultural theory, it posits that learning is a social process where knowledge is constructed through interaction and discussion with others. Laal and Laal (2012) argue that optimal learning occurs through active participation and peer collaboration, where students discuss ideas and gain new insights. In collaborative learning, students work in groups to achieve common goals, with interaction and discussion being crucial to learning. Teachers act as facilitators, providing guidance and support as needed. Collaborative learning can occur face-to-face or online using technological tools. Research indicates collaborative learning promotes higher-order thinking skills and improves learning achievement while enhancing social skills and motivation (Ghavifekr, 2020). However, it requires careful planning and a well-structured environment to be effective (Stahl, 2023). Challenges of collaborative learning include ensuring individual accountability, managing team dynamics, and assessing individual contributions. Technology platforms like the metaverse and social media for collaborative learning also raise new considerations regarding privacy, security, and data access (Jovanović & Milosavljević, 2022; Ansari & Khan, 2020).

What is Active Learning?

Active learning promotes student engagement by directly involving them in acquiring knowledge, skills, and understanding (Ruijuan et al., 2023). Freeman et al. (2014) found active learning improves student performance, especially in STEM fields. The advantages of active learning include: 1) improving exam scores and reducing failure rates; 2) fostering collaboration between students and teachers; and 3) increasing student engagement, leading to better retention and understanding (Freeman et al., 2014; Sølvberg, 2023). However, active learning faces challenges in higher education, including institutional inertia and infrastructure coordination (Børte et al., 2023). Aini (2020) notes that implementing active learning requires careful planning and design, using tools like the ADDIE model to ensure material effectiveness. Støckert et al. (2020) highlight using collaborative learning spaces, such as the "Portal" system in a master's program, to promote cross-campus and team-based learning.

Relationship Between Collaborative Learning and Active Learning

Collaborative and active learning, as interconnected concepts, often complement each other. Collaborative learning focuses on collective student efforts, while active

learning emphasizes engagement in diverse activities. Numerous studies have confirmed that both methods effectively enhance student engagement. Qureshi et al. (2023) found that social media and active collaborative learning significantly improved student engagement, satisfaction, and achievement. Additionally, collaborative and active learning strategies can lead to superior learning outcomes. Menacho-Vargas et al. (2022) found that using Canva in virtual environments promotes collaborative learning and improves engagement and learning outcomes. Instructors' teaching methods also significantly impact students' group learning and their ability to enhance learning through collaborative activities (Chang-Tik, 2023). Technology integration plays a crucial role in supporting collaborative and active learning. Wang & Wang (2023) demonstrated how capsule networks in hyperspectral image classification promote active learning and collaboration.

Research Methodology

Research Design

This study investigates the impact of a blended instructional approach combining collaborative and active learning on vocational students' learning achievement and self-motivation. The research is divided into three phases: 1) the first focuses on designing the blended instructional approach. A comprehensive literature review was conducted on collaborative learning, active learning, learning achievement, and self-motivation. In collaboration with teachers, the Chinese freshman telecommunications principles textbook was analyzed. The teaching model was designed, and scales and tests were developed based on the textbook's characteristics and collaborative and active learning elements. 2) The second phase is the validation and revision stage. The experiment group participated in a one-month intervention using the collaborative and active learning model. The group was assessed using skill assessment scales and tests. Research data analysis assessed the reliability and validity of the tools, leading to revisions of the teaching model. 3) The final phase is the implementation stage. The study utilized an equivalent control group design with a significance level (α) of 0.05. Pre-tests were administered to the experimental and control groups to evaluate their baseline learning achievement and self-motivation. Over one month, post-tests were conducted to measure the effectiveness of the instructional methods, facilitating a comparative analysis.

Research Variables

This study investigates the effects of different instructional methods on vocational students' learning achievement and self-motivation. The independent variable is the

instructional method, with the experiment group using a blended approach and the control group using traditional methods. The dependent variables are learning achievement and self-motivation.

Participants

Using cluster sampling, 77 students were randomly selected from a cohort of 290 freshmen at Liuzhou Vocational and Technical College. These students were randomly assigned to the experiment group (27 students), the control group (25 students), and the validation group (25 students). The average age for the control group was 17.4 years, and for the experiment group, it was 17.8 years. All participants had similar academic backgrounds and studied the same major.

Intervention

The intervention took place in natural classroom settings at Liuzhou Vocational and Technical College. Initial assessments of students' learning achievement and self-motivation were conducted through pre-tests. Subsequently, a blended instructional approach combining collaborative and active learning was introduced, designed to foster a collaborative environment that enhances academic achievement and self-motivation (Table 1). This environment was achieved by assigning practical, challenging tasks, offering guidance and support, emphasizing collaboration, and promoting active learning. Students worked in groups to complete tasks, participate in discussions, and collaboratively solve problems.

Teachers served as coaches and guides, offering resources, technology, and feedback to support student learning. The instructional framework was designed to develop students' collaborative, analytical, presentation, and problem-solving skills and their interest and initiative in learning. The instructional process included 20 sessions, each lasting 45 minutes. Following the instructional period, post-tests evaluated improvements in students' learning achievement and self-motivation. The comparison of pre-test and post-test data highlights this instructional approach's impact on students' learning achievement and self-motivation, offering insights for future educational practice.

Table 1. Instructional Design: Objectives, Resources, and Time Allocation

Instructional Design	Details
Teaching Objectives	1. Increase student engagement and motivate them to apply themselves in their learning activities. 2. Foster mutual understanding and enhance collaboration through improving communication skills. 3. Promote analytical thinking and encourage a focus on producing outcomes. 4. Inspire students to explore unfamiliar concepts and adopt a proactive attitude.
Teaching Resources	1. Group Allocation: Organize students into groups (4-6 people) to promote interactive learning and teamwork. 2. Collaborative Tools: Provide tools such as whiteboards, shared documents, and online platforms for effective communication and cooperation. 3. Resources: Supply teaching notes, reference materials, and web links. 4. Technical Support: Ensure students have the necessary technology and skills to complete their tasks.
Teaching Time	90 minutes

Table 1 presents the foundational goals, resources, and time allocations for this intervention, establishing a framework for understanding each activity's expected outcomes and the support structure fostering a conducive learning environment. Based on this foundation, Table 2 details the execution of each instructional phase, illustrating how collaborative and active learning components were integrated throughout each session. This progression from Table 1 to Table 2 reflects a logical transition from instructional planning to practical application, aligning each phase with the intended educational objectives.

Table 2. Teaching Process

Phase	Description	Duration
Introduction Phase	Define task objectives and expectations. Explain collaborative activities and motivate students to share ideas.	10 minutes
Task Design Phase	Design a practical, team-based task requiring innovative solutions. Provide learning materials and technical support.	15 minutes
Group Collaboration	Facilitate teamwork and idea-sharing within groups. Ensure active participation from all students.	25 minutes
Active Learning Phase	Promote critical thinking and curiosity through questions and exploration. Encourage students to engage in various activities such as experimenting.	20 minutes
Teacher Guidance	Provide feedback and guide students through tasks. Create a supportive learning environment.	10 minutes
Summary and Evaluation	Students present their results and reflections. Evaluate student performance and provide feedback.	10 minutes

Research Hypotheses

H1: The blended instructional approach combining collaborative and active learning will improve first-year students' learning achievement and self-motivation compared to their pre-intervention levels.

H2: The blended instructional approach, which combines collaborative and active learning, will result in higher learning achievement and self-motivation in first-year students compared to the control group.

Research Instruments

Academic Achievement Test Papers (AATP)

The Academic Achievement Test Papers (AATP) consist of 50 multiple-choice questions, each worth 2 points, for a total of 100 points. The pretest will assess students' learning achievement before and after the course. A question bank will prevent pretest results from affecting post-test results and maintain consistent difficulty across tests. Questions will be randomly selected for the pretest and post-test to ensure

no repetition. This ensures that each student encounters a unique set of questions, preventing any influence of the pretest on post-test results.

Additionally, this method ensures that the difficulty level remains consistent across both tests. Questions will be categorized into manageable (20), medium (20), and challenging (10) levels and randomly selected for both the pretest and posttest. Five field experts rigorously reviewed the AATP, deeming it high-quality.

Self-motivation Assessment Scale

The Self-Motivation Assessment Scale (SMAS) includes five dimensions: Interest and Engagement, Participation and Collaboration, Focus and Perseverance, Self-Encouragement and Positive Attitude, and Self-Estimation and Career Development, with two questions per dimension, totaling 10 questions. The widely recognized Likert 5-point scale ensures objective and accurate scoring. By evaluating specific items within these dimensions, teachers can understand students' eagerness to learn and provide appropriate support. SMAS provides educators with a detailed guide to enhance students' motivation, encouraging participation, goal-setting, problem-solving, concentration, perseverance, and self-study while building confidence for future careers. Five trained teachers will assess 27 students from the experiment group and 25 from the control group, with each teacher evaluating 5-6 students to ensure comprehensive and accurate assessments. SMAS was deemed high-quality after a rigorous review by five experts.

Data Analysis

SPSS statistical software was used to analyze the AATP and SMAS scores. The data were analyzed using ANOVA and t-tests to examine 1) differences between pre-test and post-test results and 2) distinctions between the experiment and control groups. The threshold for statistical significance was established at $p < 0.05$, with Cohen's d values of 0.2, 0.5, and 0.8 signifying small, medium, and large effect sizes, respectively.

Ethical Approval

This study received formal approval from the Ethics Committees of Liuzhou Vocational and Technical College and Nakhon Phanom University. Before providing voluntary consent, participants were fully informed about the study's purpose, methods, potential risks, and their rights and obligations. The study adhered to ethical guidelines, taking continuous measures to protect participants' legal rights and the confidentiality of their personal information.

Results

Comparison of Pre-test and Post-test in the Experiment Group.

Table 3 compares academic achievement between pre-test and post-test scores for a sample of 27 participants. The mean academic achievement score increased from 79.63 (SD=6.77) in the pre-test to 86.15 (SD=5.74) in the post-test. The t-test for paired samples indicated a statistically significant improvement ($t=19.72$, $p<0.05$) with a large effect size (Cohen's $d=3.794$). Similarly, the self-motivation scores increased from the pre-test ($M=37.82$, $SD=3.98$) to the post-test ($M=42.74$, $SD=3.03$). The paired samples t-test also revealed a statistically significant enhancement ($t=19.71$, $p<0.05$) with a large effect size (Cohen's $d=3.793$).

Table 3. Comparison of Pre-test and Post-test in the Experiment Group.

Variable	N	Mean	SD	t	P	Cohen's d
Academic Achievement pre-test	27	79.63	6.77	19.72	0.000*	3.794
post-test Self-motivation	27	86.15	5.74			
pre-test	27	37.82	3.98	19.71	0.000*	3.793
post-test	27	42.74	3.03			

Note: *P<0.05.

The results indicate significant improvements in academic achievement and self-motivation following the intervention. The larger effect size can be attributed to the intensive and targeted nature of the instructional approach, which offers students direct engagement and hands-on experience, leading to a deeper understanding of the material and higher self-motivation. The increase in mean scores from pre-test to post-test in both variables suggests that the intervention positively impacted students' performance and motivation. The high t-values and corresponding p-values (<0.05) reinforce the reliability of these findings, confirming the robustness of the improvements observed.

Comparison of Experiment Group Pre-test with Control Group Pre-test

Table 4 compares pre-test scores between the experimental and control groups. In academic achievement, the control group ($N=25$) had a mean score of 77.84 ($SD=6.38$), while the experiment group ($N=27$) had a mean score of 79.63 ($SD=6.77$). The independent samples t-test showed no statistically significant difference ($t=0.98$, $p>0.05$), with a small effect size (Cohen's $d=0.272$). This indicates that the two groups

had no significant disparity in academic achievement before the intervention. Similarly, the self-motivation scores were compared. The control group had a mean score of 36.48 (SD=3.11), and the experimental group had a mean score of 37.82 (SD=3.98). The t-test for this comparison yielded a t-value of 1.34 and a p-value of 0.186, which is not statistically significant (p>0.05). The effect size was moderate (Cohen's d=0.372), indicating a noticeable difference in mean scores, but not enough to conclude a significant effect from the intervention at this stage.

Table 4. Comparison of Experiment Group Pre-test with Control Group Pre-test

Variable	N	Mean	SD	t	P	Cohen's d
Academic Achievement						
Control Group	25	77.84	6.38	0.98	0.332	0.272
Experiment Group Self-motivation	27	79.63	6.77			
Control Group	25	36.48	3.11	1.34	0.186	0.372
Experiment Group	27	37.82	3.98			

Note: *P<0.05.

The results indicate that, prior to the intervention, there were no significant differences in academic achievement or self-motivation between the experimental and control groups. This baseline equivalence is crucial for ensuring that any post-test differences can be more confidently attributed to the intervention itself rather than pre-existing differences between the groups. The small and moderate effect sizes for academic achievement and self-motivation suggest that observed differences are likely due to random variation rather than systematic effects from the intervention.

Comparison of Experiment Group Post-test with Control Group Post-test

Table 5 compares post-test scores between the experimental and control groups. The academic achievement mean score for the control group (N=25) was 80.16 (SD=6.03), whereas the experiment group (N=27) had a significantly higher mean score of 86.15 (SD=5.74). The independent samples t-test indicated a statistically significant difference (t=3.67, p<0.05) with a large effect size (Cohen's d=1.019). This substantial effect size suggests that the difference in academic achievement between the groups is not only statistically significant but also of practical importance. For self-motivation, the control group had a mean score of 38.40 (SD=2.84), while the experiment group's mean score was markedly higher at 42.74 (SD=3.03). The t-test for this comparison also revealed a statistically significant enhancement (t=5.31, p<0.05) with an even larger effect size (Cohen's d=1.475). This indicates a meaningful improvement in self-motivation for the experiment group.

Table 5. Comparison of Experiment Group Post-test with Control Group Post-test

Variable	N	Mean	SD	t	P	Cohen's d
Academic Achievement Control Group	25	80.16	6.03	3.67	0.001*	1.019
Experiment Group	27	86.15	5.74			
Self-motivation Control Group	25	38.40	2.84	5.31	0.000*	1.475
Experiment Group	27	42.74	3.03			

Note: *P<0.05.

The results indicate substantial improvements in academic achievement and self-motivation for the experiment group post-intervention. The enormous effect sizes and significant p-values indicate a profound positive impact on learning achievement and self-motivation. The high demand for practical skills and real-world applications explains this outcome in vocational education. This instructional approach aligns with vocational students' learning needs by emphasizing hands-on practice and task completion, enabling them to apply learning to practical skills. Furthermore, collaborative and active learning fosters a deeper understanding of the subject matter while enhancing students' autonomy and sense of ownership in the learning process. When students actively engage with tasks and work in groups, they experience increased social support and develop essential problem-solving skills, contributing to heightened motivation and academic success.

Structured interaction in collaborative settings helps students build confidence by sharing ideas and receiving peer feedback. This form of learning enables them to explore different perspectives, reinforcing their ability to tackle complex tasks independently. The increased control over learning by active methods cultivates self-efficacy and persistence, contributing to the significant effect sizes. These factors create an enriched learning environment where students are more likely to achieve higher academic performance and maintain long-term motivation.

The increases in the mean scores in both variables from the control group to the experiment group underscore the effectiveness of the intervention. The high t-values and corresponding p-values reinforce the reliability and robustness of these findings, confirming that the improvements observed are significant. This suggests that the blended instructional approach of collaborative and active learning enhances vocational students' academic outcomes and supports the development of critical life skills, promoting both short-term success and long-term educational benefits.

However, the small sample size in this study (only 27 students) may limit the broad applicability of the findings. The small sample size may increase the variability of the data and reduce generalizability to larger populations. Nevertheless, the large effect

sizes and significant results suggest that this sample's instructional approach was highly effective.

Discussion

The study investigates the impact of collaborative and active learning on vocational students' learning achievement and self-motivation. The experimental results show significant improvements in the experiment group's learning achievement and self-motivation, indicating that the combined method enhances self-motivation. Thus, Hypothesis 1 is supported. The control group showed minor improvements, while the experiment group demonstrated significant post-test progress, confirming the method's effectiveness. Thus, Hypothesis 2 is also supported.

The study's findings reveal that collaborative learning significantly enhances vocational students' learning achievement. This result aligns with existing literature, such as Yuretich et al. (2001), which found that implementing cooperative learning in classroom exercises and guided discussions improves students' learning outcomes. Sipayung et al. (2018) found that the collaborative inquiry learning model enhances students' 4C skills (collaboration, communication, critical thinking, and creativity) compared to traditional methods. In this study, the experiment group improved academic performance and teamwork through collaboration, task sharing, and information exchange. In vocational education, collaborative learning helps students apply knowledge in real-world contexts, solve problems, and improve academic performance.

The study further confirms the positive role of active learning in enhancing students' self-motivation. Ballen et al. (2017) demonstrated that active learning disproportionately benefits underrepresented minority (URM) students, increasing learning achievement, science self-efficacy, and a sense of social belonging in STEM courses. In this study, the experiment group enhanced their understanding, memory, interest in learning, and intrinsic motivation through task design, problem-solving, and active exploration. This suggests that active learning, which promotes autonomous learning, effectively enhances self-motivation, leading to greater engagement when facing challenges.

The combination of collaborative learning and active learning can produce complementary effects. Challenges in the curriculum, such as varying academic preparedness, can be addressed through integration, teamwork, active learning, and technology, as Morgan et al. (1998) noted. Detyna et al. (2024) found that combining active learning with collaboration and simulation improves content understanding, learner engagement, and knowledge retention. Our results confirm this, showing significant improvements in the experiment group's academic performance and self-

motivation after adopting the combined method. This synergy likely results from collaborative learning providing team support and communication, while active learning fosters autonomy and responsibility, encouraging proactivity and higher outcomes.

Despite the positive findings, this study has several limitations. First, the sample was limited to first-year students at Liuzhou Vocational and Technical College, and the small sample size may affect generalizability. Future research could include more schools and students from various grades to improve the generalizability of the findings. Second, this study relied primarily on quantitative data and did not explore students' specific experiences and feedback during collaborative and active learning. Future studies could incorporate qualitative methods, such as interviews and observations, to gain deeper insights into students' experiences and provide more comprehensive references for optimizing instructional approaches.

Scaling up these instructional approaches presents logistical and practical challenges. Successful application requires teachers with extensive classroom management skills who can effectively manage team dynamics and provide targeted feedback. In China, recruitment standards for vocational college teachers now require master's degrees, with "dual-teacher" qualifications becoming more desirable (Xue & Li, 2022). The overall improvement in teacher quality has supported the implementation of innovative instructional approaches. Adequate teaching resources (e.g., time management, technological tools, and personalized support in large classes) are vital for improving teaching quality (Delgado et al., 2015). Differences in resource allocation across schools may lead to variations in implementation.

Another consideration is students' academic preparation and socioeconomic conditions. Vocational students often have diverse academic backgrounds, with some needing more foundational knowledge or self-regulation (McInerney & King, 2017). Individual differences must be considered to balance students' starting points for learning through upfront academic assessment and support. Socioeconomic backgrounds, such as limited access to stable internet or a conducive learning environment, may affect resource access (Fabito et al., 2020). Future research should explore how these external factors affect instructional outcomes and suggest inclusive strategies for students from diverse backgrounds.

Future research could incorporate qualitative methods, like interviews and observations, to gain insights into students' learning experiences. For example, examining students' feelings during group learning, their perceptions of self-learning, and how these approaches affect their confidence in future career development. This will provide more comprehensive data to support the optimization of instructional approaches in vocational education.

Conclusion

In this study, comparative analysis revealed that an instructional approach combining collaborative learning and active learning significantly improved vocational students' academic performance and self-motivation. The results suggest that this approach promotes interaction and knowledge sharing while enhancing students' motivation and autonomy. However, the small sample size (27 students) may limit the generalizability of the results. The short experimental period (one month) may only partially capture the long-term impact of these approaches on student development. Future studies should include larger samples and longer experimental periods to assess the long-term effects of these approaches on learning outcomes and motivation. Future research could also incorporate qualitative methods, such as interviews and observations, to explore students' learning experiences in greater depth. This will provide a more comprehensive basis for optimizing instructional approaches in vocational education.

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