The Development of an Instructional Model based on Work-Based Learning to Improve the Metacognitive Skills

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Abstract

The objectives of this study were (1) to study the factors that affect the development of metacognitive skills, (2) to develop an instructional model for improving metacognitive skills based on work-based learning, and (3) to compare students' metacognitive skills before and after using the work-based learning instructional model. The sample group was 40 students from the highway engineering supervision major of Qinghai Communications Technical College. The research was conducted in three steps: studying the factors that affect the development of metacognitive skills, developing the instructional model, and the experimental and improvement process. The research instruments were a questionnaire about factors that affect the development of metacognitive skills, an interview form about factors that affect the development of college students' metacognitive skills, an observation form about student behavior, an interview form about opinions on teaching, lesson plans, and a metacognitive skills test. The study's results were 1) the main factors affecting the development of metacognitive skills include the learning process, the environment, the teachers, and the students, respectively, 2) the instructional model based on work-based learning was developed consisting of four core components: a) principles, b) objectives, c) learning process, and d) results, and 3) after the implementation of the instructional model based on work-based learning, the metacognitive skill scores of the students were higher than the metacognitive skills of the students before the experiment, with a statistical significance of 0.01 level.

Keywords: instructional model development, work-based learning, metacognitive skills

1. Introduction

1.1 Introduce the Problems

In 2015, UNESCO unveiled the Education 2030 Framework for Action, a 2030 Agenda for Sustainable Development cornerstone. This framework sets ambitious goals, including the delivery of high-quality technical, vocational, and higher education. It also aims to substantially boost the number of young people and adults with relevant and crucial skills for sustainable development. Within this framework, vocational education is highlighted explicitly as a pathway for developing technical skills and competencies. The attention must be focused on two critical dimensions: First, from the student's education level, the acquisition of 'relevant skills' is paramount. However, this term should not be limited to skills that are merely job-specific. Instead, it should include a broader set of higher-level cognitive and transferable skills, such as metacognitive abilities. These skills are invaluable in the workplace and equip students to adapt to rapidly changing job landscapes. In doing so, students lay a strong foundation for lifelong learning and career adaptability. Second, from the teacher’s standpoint, the emphasis should be on providing a high-quality curriculum aligned with the student’s needs. The framework suggests multiple strategies for enhancing work-based training and learning, identified as the most effective methods for improving practical skills. The framework recommends increasing the number of well-trained teachers and exploring innovative approaches to

skills-based education. Teachers can implement work-based instructional models geared toward functional, work-oriented outcomes. These models can also foster metacognitive skills, enriching the learning experience (Mundial & UNICEF, 2016). By focusing on these two dimensions—students and teachers—they can work collaboratively to fulfill the Education 2030 Framework for Action objectives, thereby contributing to a more sustainable and equitable future.

In a concerted effort to achieve China's comprehensive modernization, the Ministry of Education has rolled out key initiatives aligned with the 14th Five-Year Plan and the long-term vision for 2035. These initiatives include the National Implementation Plan for Vocational Education Reform and the 2021 Vocational Education Professional Catalogue. As a result, the reform and innovation of vocational education have emerged as a cornerstone for improving the quality of vocational instruction. The vocational education landscape faces two primary challenges, particularly concerning senior students. First, many students need help fully assimilating the knowledge and skills taught during their courses. Second, even those who excel academically often need help adapting these skills to meet real-world work requirements. This glaring disconnect between academic preparation and workplace expectations is a pressing issue that demands immediate attention. The work-based teaching approach has been identified as a viable solution to these challenges. This method enhances students' essential skill sets and refines their cognitive and learning capabilities. Focusing on professional skills development provides students with a well-rounded educational experience, instilling a sense of professionalism and achievement. These competencies offer students a competitive advantage in the job market upon graduation.

Furthermore, their vocational training is a strong foundation, enabling them to adapt more readily to new roles and responsibilities in their subsequent careers. The level of professional skills attained can also impact their earning potential and career progression, ultimately contributing to their overall well-being. From an employer's perspective, there is a solid inclination to hire recruits with specialized skills that enable immediate productivity with little to no additional training. However, a discernible gap exists between the skills imparted by educational institutions and the practical needs of the business sector. This mismatch often compels companies to invest additional time and resources in upskilling their new hires. Therefore, individuals with well-honed professional skills are valuable and indispensable assets for organizations, playing a pivotal role in their growth and innovation.

1.2 Rationale of the Study

The concept of metacognition was introduced by Flavell in 1976 and has been developed for more than 40 years. The idea of metacognition and its importance have become deeply rooted. Metacognitive skills are commonly understood as "cognition about cognition." These are strategies consciously or automatically applied during learning, cognitive activities, and communication to control cognitive processes before, during, or after mental activities. Metacognitive skills encompass planning, monitoring, and regulation (Flavell, 1976, 1979; Patterson, 2011). While school teachers recognize the importance of metacognition for students, heavy teaching loads often leave little opportunity or time to instruct students in these skills. Many students remain unaware of the concept of metacognition, and even those who are aware may not know how to apply metacognitive skills to enhance learning. Research has shown that improving metacognitive skills can boost students' initiative, hone their thinking skills, and enhance academic performance (Muhid et al., 2020). Metacognitive skills are not innate; they require cultivation later in life. Once developed, these skills tend to persist. During metacognitive training, the need to control one's learning activities—such as achieving relevant learning goals, selecting appropriate learning methods, and reflecting on and regulating the learning process after completion—underscores the critical role of metacognitive skills in educational success (Livingston, 2003).

Several areas could be improved in students' application of metacognitive skills during the actual learning process. For instance, students often struggle to set realistic plans, and the goals they do set may not align with their essential capabilities. Students frustrated with learning may create plans but require assistance to execute them. Repeated failures can erode their confidence. Additionally, there is the issue of students needing help to self-monitor effectively. For example, a student may plan to study for one hour a day but fail to ensure the effectiveness of that study hour without even realizing it (Butler & Winne, 1995). Some students can set reasonable plans and monitor their progress but struggle to adapt their learning strategies (Artino et al.,2022). There are also instances where students with poor metacognitive skills lack external guidance. Metacognitive skills are related to academic performance, problem-solving, lifelong learning, and future work performance. Their importance cannot be overstated (Hattie & Yates, 2014). To address these issues, teachers are developing work-based learning instructional models and intervening to help students improve their metacognitive skills (Paris & Paris, 2001).

The Highway Engineering Supervision major at Qinghai Communications Technical College is a specialized program designed to meet the unique transportation engineering needs of the Qinghai-Tibet Plateau. Targeting high

school graduates who have either taken the college entrance exam or participated in the school's individual admissions test, the program aims to produce highly skilled technical and applied professionals. These graduates are trained to excel in various aspects of highway supervision, including quality control, cost management, and contract administration for highways, bridges, and tunnels. The curriculum is meticulously structured to cover five critical stages of highway engineering supervision: from survey and design to bidding, testing, active engineering supervision, and finally, completion acceptance. This comprehensive approach is further enriched by focusing on five core competencies: cost supervision, safety oversight, quality assurance, progress monitoring, and contract management. This multi-faceted training model is specifically tailored to the unique conditions of the Qinghai-Tibet Plateau, seamlessly integrating theoretical instruction with practical application. Unlike traditional foundational courses such as Chinese and mathematics, this significant emphasizes specialized knowledge and real-world problem-solving skills. The program aligns its teaching methods and objectives with a well-defined talent training model, ensuring that students acquire professional practical skills immediately applicable in the field. Recognizing the crucial role of metacognitive skills in enhancing functional work capabilities and problem-solving, the program has identified the cultivation of these skills as a critical quality goal for student development (Qinghai Communications Technical College, 2022a, 2022b).

Based on the previous discussion about the importance of metacognitive skills, it's clear that these skills are integral to the quality goals for students majoring in highway engineering supervision. Feedback from enterprises evaluating recent graduates indicates a significant deficiency in the student’s mastery of practical skills. Providing a learning environment mimicking real-world work conditions is essential to address this issue. Work-based learning typically involves teaching skills that align with actual work processes (Jiang, 2004). The approach transforms traditional subject-based teaching into work tasks modeled after real-world scenarios. Each task is taught following its corresponding workflow, effectively integrating theory with practice (Wang & Sheng, 2019). This method not only resolves the issue of students' poor practical skills but also allows them to learn while working, thereby enhancing their overall skill set.

Teachers incorporate metacognitive strategies into daily instruction, enabling students to reflect on and evaluate their learning experiences and problem-solving abilities. This work-process-based teaching significantly enhances students' metacognitive skills (Jiang, 2017; Wu et al., 2022; Yan et al., 2019). Work-based learning effectively bridges the gap between classroom instruction and real-world work requirements while fostering metacognitive skills development.

In summary, metacognitive skills are important to students, and metacognitive abilities can be well exercised and improved by work-based learning. Therefore, the researcher is interested in developing an instructional work-based learning model to improve the metacognitive skills of engineering highways at Qinghai Communications Technology College.

1.3 Research Objectives

(1) To study the factors that affect the development of metacognitive skills

(2) To develop an instructional model for improving metacognitive skills based on work-based learning

(3) To compare students' metacognitive skills before and after using the work-based learning instructional model

1.4 Research Hypothesis/Hypotheses

Students had higher metacognitive skills after using an instructional model based on work-based learning.

1.5 The Variable

Independent Variable: Instructional model based on work-based learning

Dependent Variable: Metacognitive skills

1.6 Content (s)

This study aims to develop an instructional model based on work-based learning. The developed instructional model is used to learn metacognitive skills in the course Engineering Cost Supervision. The study of this course is divided into four units as follows.

Learning Unit 1: Highway Engineering Cost Components

Learning Unit 2: Engineering Measurement Methods

Learning Unit 3: Payment of Engineering Costs

Learning Unit 4: Supervision of Other Contract Costs

2. Method

The methodology of this research was research and development. This research was a multi-sequenced design and equivalent status design: population and sample group, research instruments, research process, and data analysis were presented as follows:

2.1 Population and Sample Group

2.1.1 Population

The population of this study were students in the 2020 academic year of the Highway Engineering Supervision major at Qinghai Communications Technical College, including 97 students.

2.1.2 The Sample Group

Through the random cluster sampling method, 40 students in one class were selected from the highway engineering supervision major of Qinghai Communications Technical College.

2.2 Research Instruments

Research instruments were presented as follows:

(1) Questionnaire about factors that affect the development of metacognitive skills

(2) Interview form about factors that affect the development of college student's metacognitive skills

(3) Observation form about Student behavior

(4) Interview form about opinions on teaching

(5) Lesson plans

(6) Metacognitive Skills Test

2.3 Research Process

This research was conducted in three steps: studying the factors that affect the development of metacognitive skills, the development of instructional models, and the experimental and improvement process. The research process was presented as follows:

2.3.1 Step 1 Studying Factors that Affect the Development of Metacognitive Skills

The details of step 1 are as follows:

(1) Collect data about factors that affect the development of metacognitive skills from 5 Academic experts by using a questionnaire about factors that affect the development of metacognitive skills and an interview form about factors that affect the development of college students' metacognitive skills.

(2) Analyze data about factors that affect the development of metacognitive skills by $\bar{x}$ and SD. and content analysis

(3) Conclude data and use to develop an instructional model

2.3.2 Step 2 The Development of Instructional Model

The process of development of the instructional model is presented as follows.

(1) Studied Instructional model development process

(2) Determined the instructional model components

(3) Drafted the details of the instructional model: principle, objective, learning process, and result

(4) Verified the details of instructional mode by the five professional scholars and modified instructional model according to suggestion

(5) Modify the detail of the instructional model according to suggestions

2.3.3 Step 3 Experimental and Improvement Process

The details of the experimental and improvement process are presented as follows:

(1) Third-year students with metacognitive skills majoring in highway engineering supervision at Qinghai Communications Technical College were tested before using the instructional model through the Metacognitive Skills Test

(2) Third-year students with Metacognitive Skills majoring in highway engineering supervision at Qinghai Communications Technical College were experimented with using four units /4 lesson plans according to the instructional model for 20 hours: 5 weeks, with 240 minutes of lessons per week.

(3) The researcher observed and interviewed the third-year College students majoring in highway engineering supervision at Qinghai Communications Technical College about the activities gained after learning from lesson plans according to the instructional model.

(4) Third-year students majoring in highway engineering supervision at Qinghai Communications Technical College were tested after using an instructional model through the Metacognitive Skills Test.

(5) Analyse data and improve instructional models according to data.

2.4 Data Analysis

The data are analyzed as follows.

(1) Qualitative data are analyzed through content analysis.

(2) Quantitative data are analyzed through descriptive statistics; frequency, percentage, means, and standard deviation, and the different scores of metacognitive skills before and after using the instructional model are analyzed through t–test for dependent.

3. Results

Research results are presented as follows.

3.1 Results on Factors Affecting Metacognitive Skill Development

Table 1. Summary table of influencing factors

Factors	$\overline{x}$	S.D.	scoring rate %	Ranking within All Factors
Student	3.8	0.869	76	4
Teacher	4.23	0.465	84.6	3
Learning processes	4.36	0.41	87.2	1
Environment	4.35	0.72	87	2
Total Average of Environment	4.19	0.62	83.8	

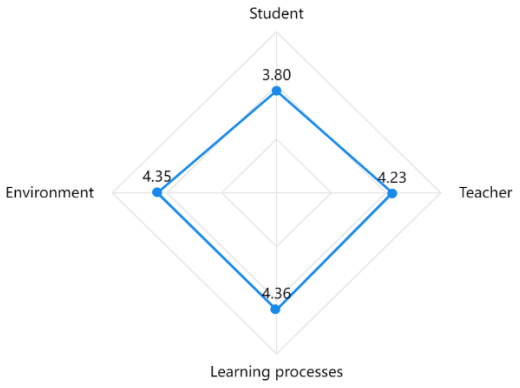

Figure 1. Comparison radar chart of the average value of influencing factors

Table 1 and Figure 1 Indicate that all factors affecting students' metacognitive skills development at Qinghai Communications Technical College are generally found at a high level ($\overline{x}$=4.19). Considering only each item, it was found that Factor Learning processes are the high mean ($\overline{x}$= 4.36), followed by Factor Environment ($\overline{x}$=4.35), and the fewest norm is Factor Student ($\overline{x}$=3.8). The results above are teachers' questionnaires on the factors affecting the

development of metacognitive skills and summarize the factors that affect the development of students' metacognitive skills. These factors present results using mean, standard deviation, scoring rate, and ranking of all factors.

3.2 Results of Developing an Instructional Model based on Work-based Learning

The Instructional model consists of 4 components, as follows.

3.2.1 Principle

Work-based learning employs a holistic approach that integrates theoretical knowledge with practical application, equipping students with a comprehensive understanding of the work process and the skills required for the job (Wang & Sheng, 2019). This educational model serves a dual purpose: it addresses students lacking practical skills and creates an environment where learning and working coexist. This synergy is particularly effective in nurturing metacognitive skills. Through consistent, daily interactions rooted in real-world work processes, students are encouraged to engage in self-reflection and evaluation. This process, in turn, enhances their ability to analyze situations and solve problems more effectively. Research supports the idea that work-based learning is a potent catalyst for developing metacognitive skills, significantly elevating students' cognitive abilities (Jiang, 2017; Wu et al., 2022; Yan et al., 2019).

3.2.2 Objective

Through learning based on the work-based learning instructional model, students can improve their metacognitive skills, including metacognitive planning, monitoring, and evaluating skills.

3.2.3 Learning Process

Step 1: Introduction

(a) The teacher first introduces the content and learning objectives of the lesson to the students, detailing the significance and importance of these objectives.

(b) To stimulate students' interest in learning, the teacher defines basic concepts and introduces real-world examples related to the new lesson.

(c) The teacher guides students to preview relevant content using the materials provided. Students are encouraged to take a preview test on the teaching platform's cloud class. Students should employ metacognitive planning skills during this preview to set learning goals, strategies, and outcomes.

Step 2: Teacher-led Learning

(a) The teacher explains the background of an actual work case and outlines the tasks that students will complete.

(b) The teacher then leads the students in collaboratively completing these tasks.

Step 3: Student Practical Exercises

(a) The teacher presents students with a new practical work case and requires them to complete work tasks independently in class, following a learning plan.

(b) Students must examine their learning from a third-party perspective while completing these tasks.

(c) Students are encouraged to monitor their learning in real time.

(d) After completing the tasks, students are prompted to reflect on and review their work-based learning experiences, focusing on the impact on their metacognitive skills through methods like student diaries or self-monitoring exercises.

Step 4: Panel Discussion

(a) Students are asked to discuss work tasks in small groups.

(b) The discussion encourages students to share experiences and insights, fostering self-awareness and metacognitive skills. Teachers check students' learning outcomes and address any questions related to metacognitive monitoring skills.

Step 5: Learning Review

(a) After classroom teaching, teachers assign course-related knowledge tasks.

(b) Students are instructed to use evaluation strategies to assess their learning.

3.2.4 Result

Students improve their metacognitive skills, including planning, monitoring, and evaluating.

3.3 Metacognitive Skill Improvement Results

The results are presented in 2 ways in this section: (1) comparing students' metacognitive skills before and after the experiment using a t-test for the one-sample group, which provides the significant difference between before and after learning outcomes, and (2) reporting individual relative development scores and increased percentages and assessing the level of development.

Table 2. Comparison between students' metacognitive skills before and after learning through the work-based learning instructional model

metacognitive skills	Scores	N	$\overline{x}$	S.D.	df	T	Sig. (2-tailed)
Metacognitive planning skills	post-test scores	40	36.98	5.47	39	7.62	0.000**
	pre-test scores	40	31.83	4.63			
Metacognitive monitoring skills	post-test scores	40	37.03	5.71	39	8.74	0.000**
	pre-test scores	40	31.13	4.63			
Metacognitive Evaluating skills	post-test scores	40	37.05	5.47	39	8.56	0.000**
	pre-test scores	40	31.53	4.68			
Summary	post-test scores	40	111.05	16.09	39	9.03	0.000**
	pre-test scores	40	94.48	13.34			

** $p<0.01$

From Table 2, the pre-test is different from the post-test by metacognitive planning skills (pre-test $\overline{x}$ = 31.83 post-test $\overline{x}$ =36.98). The results from the t-test show the t-value of metacognitive planning skills, which is higher than the t-distribution (|t|=7.62) and p-value = 0.000 (** $p<0.01$). Then, it can be summarized that the given treatment influences students' metacognitive planning skills at a significance level of 0.01.

The pre-test is different from the post-test by metacognitive monitoring skills (pre-test $\overline{x}$ = 31.13 post-test $\overline{x}$ =37.03). The results from the t-test show the t-value of metacognitive monitoring skills, which is higher than the t-distribution (|t|=8.74) and p-value = 0.000 (** $p<0.01$). Then, it can be summarized that the given treatment influences students' metacognitive monitoring skills at a significance level of 0.01.

The pre-test differs from the post-test by metacognitive evaluating skills (pre-test $\overline{x}$ = 31.53 post-test $\overline{x}$ =37.05). The results from the t-test show the t-value of metacognitive evaluating skills, which is higher than the t-distribution (|t|=8.56) and p-value = 0.000 (** $p<0.01$). Then, it can be summarized that the given treatment influences students' metacognitive evaluating skills at a significance level of 0.01.

Overall， the pre-test differs from the post-test by metacognitive skills (pre-test $\overline{x}$ = 94.48 post-test $\overline{x}$ =111.05). The results from the t-test show the t-value of metacognitive skills, which is higher than t-distribution (|t|=9.03) and p-value = 0.000 (** $p<0.01$). Then, it can be summarized that the given treatment influences students' metacognitive skills at a significance level of 0.01.

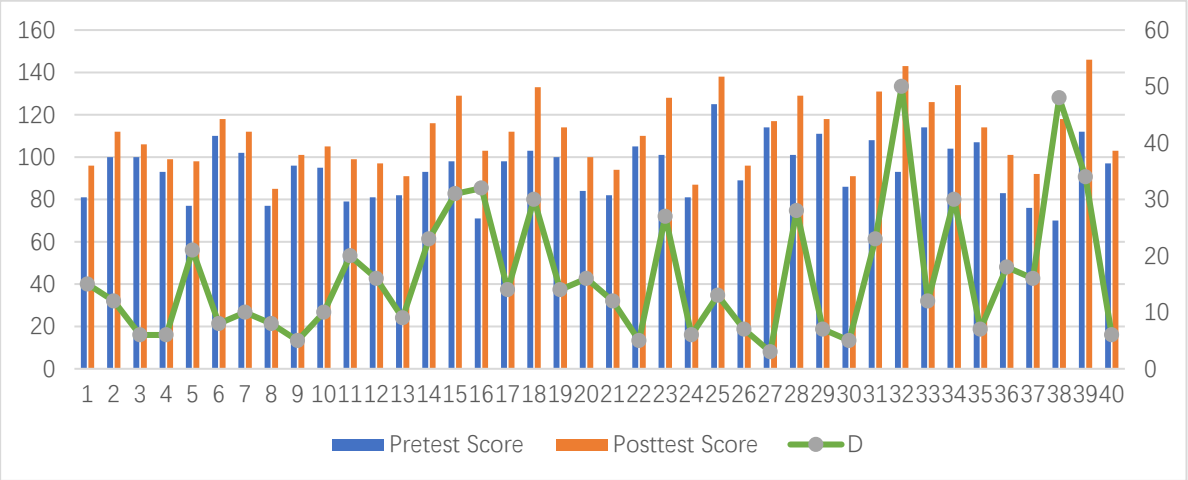

Figure 2. pre-test score, post-test scores, and increasing percentage of individual students' metacognitive skills

Figure 2 Indicates that all students' metacognitive skills at Qinghai Communications Technical College are generally found at a high level. The pre-test score is 94.48, and the post-test score is 111.05. The scores increased by 16.57 compared with the pre-test. Considering only each item, it was found that No.32 students had the highest increase (D=50), followed by No.38 students (D=48), and the fewest Increased percentage is No.27 students (D=3).

Table 3. Number of students with metacognitive skill improvement in different score bands

Increased score range	number of people	Rank
0-9	14	1
10-19	13	2
20-29	6	3
30-39	5	4
40-49	1	5
50-59	1	5
60-69	0	6
Total	40	

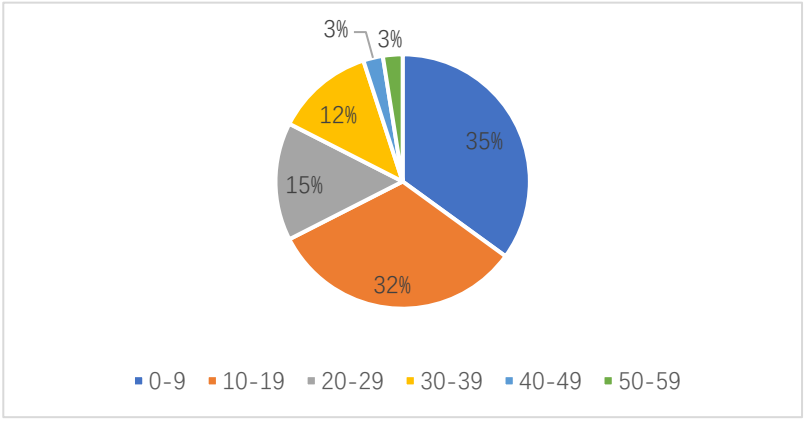

Figure 3. Percentage number of students in different score bands

Table 3 and Figure 3 indicate that the development of metacognitive skills of students at Qinghai Communications Technical College is generally improving steadily. 33 students had increased scores between 0 and 29, and the proportion of the total number of students was 82%. Considering only each item, it was found that an increased score

of between 0 and 9 is a high percentage. The proportion of the total number of students is 35%, followed by an increased score of between 10 and 19, and the ratio of the total number of students is 32%.

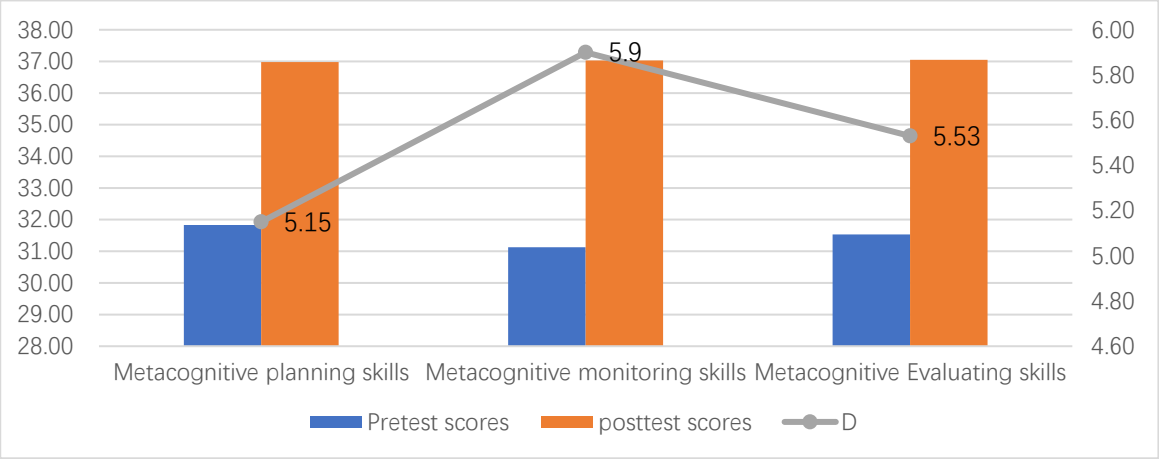

Figure 4. pre-test scores and increased scores of individual students' Metacognitive planning skills, Metacognitive monitoring skills, and Metacognitive Evaluating skills

Figure 4 Indicates that the development of Metacognitive planning skills of students at Qinghai Communications Technical College is generally found at a high level. The Metacognitive Planning Skills mean Pre-test score is 31.83, and the Metacognitive Planning Skills mean Post-test Score is 36.98, An increase Score of 5.15 compared with the Pretest. Considering only each item, it was found that the No.32 student has the highest Increased Score (D=18), followed by No.16 and No.34 and No.38 and No.39 students (D=12), and the fewest Increased Score is No.3 and No.9 and No.27 and No.40 student (D=0).

Student the development of Metacognitive monitoring skills of students at Qinghai Communications Technical College is generally found at a high level. The Metacognitive monitoring skills mean Pretest ScorPre-test.13, and the Metacognitive monitoring skills mean Post-test Score is 37.03, An increase Score of 5.90 compared with the Pretest. Considering only each item, it was found that the No.38 student had the highest Increased Score (D=20), followed by No.32 students (D=16), and the fewest Increased Score were No.30 and No.8 and No.35 and No.27 students (D=1).

Student the development of Metacognitive evaluating skills of students at Qinghai Communications Technical College is generally found at a high level. The Metacognitive evaluating skills mean Pre-test score is 53, and the Metacognitive evaluating skills mean Post-test Score is 37.05, An increase Score of 5.53 compared with the Pretest. Considering only each item, it was found that the No.38 and No.32 students had the highest Increased Score (D=16), followed by No.23 students (D=12), and the fewest Increased Score were No.3 and No.29 and No.30 students (D=0).

4. Discussion

The factors that influence the development of metacognitive skills among students at Qinghai Communications Technical College are as follows:

(1) Learning process: The factors that influence the development of metacognitive skills among Qinghai Communications Technical College students. Based on the data gathered from questionnaires and interviews, one of the most significant factors is the learning process. In particular, the role of the teacher is crucial: their learning objectives, teaching methods, and instructional design all contribute to the development of students' metacognitive abilities. This observation is consistent with research by Bae & Kwon (2021), who presented that classroom activities are a fertile ground for developing these skills. To maximize the effectiveness of this development, teachers should focus on several key areas. These include setting clear and specific objectives to enhance metacognitive skills, tackling real-world problems that students might encounter in the workplace, providing opportunities for hands-on practical experience, and integrating assessments that specifically evaluate metacognitive skills into the overall learning process.

(2) Environment: The second key factor influencing the development of metacognitive skills in college students is the learning environment. A conducive classroom atmosphere is essential for nurturing these skills. The ideal setting is relaxed and stress-free, allowing students to explore metacognitive concepts without apprehension.

Communication is another crucial element; interactions between teachers and students and among students can significantly impact metacognitive skill development. Effective communication serves as a platform for students to understand their cognitive processes better and to practice metacognitive techniques. This perspective is supported by research from Kaur & Saini (2020), who found a positive correlation between a conducive learning environment and the development of metacognitive skills. Furthermore, the availability of learning resources provides students with the opportunity for independent problem-solving and learning, which are crucial to developing metacognitive skills. Incorporating advanced technologies like big data and artificial intelligence into the classroom can enhance these skills. This notion is corroborated by Sumadyo et al. (2018), who identified the learning environment as a significant factor in fostering students' metacognitive abilities.

(3) Teachers: The third critical factor influencing the development of metacognitive skills in college students is the role of teachers. Teachers are pivotal figures in nurturing these skills, and their awareness of the importance of metacognitive development directly affects the effectiveness of such training. It aligns with the findings of Schraw et al. (2006), who emphasized teachers' crucial role in enhancing metacognitive abilities. Effective teaching strategies include clearly instructing students on metacognitive planning, monitoring, and evaluation techniques. By encouraging students to set learning goals through metacognitive planning, monitoring their learning via in-class questioning, and assisting them in self-reflection and self-evaluation through metacognitive assessment methods, teachers can significantly improve students' understanding of their learning processes. These strategies enhance learning performance and contribute substantially to developing metacognitive skills. It is supported by research from Kyriakides et al. (2020) and Nwosu et al. (2021), who found that teachers can boost metacognitive skills and academic performance by incorporating these metacognitive strategies into their instruction.

(4) Students: The students are the fourth key factor influencing the development of metacognitive skills among college students, which serves as a cornerstone for enhancing these skills. Metacognitive abilities involve the awareness and control of one's thought processes, and the level of student engagement is crucial in this context. It is consistent with Flavell's 1976 research, which highlighted the importance of student participation in metacognitive activities. Students' prior educational background and experiences are a foundation for improving metacognitive skills. Specialized knowledge in a particular subject allows students to connect new information with existing knowledge, thereby facilitating the development of metacognitive skills. Moreover, motivation is a significant determinant in the willingness to engage in metacognitive processes. Highly motivated students tend to monitor and evaluate their metacognitive activities more effectively. Self-efficacy also plays a role; students' beliefs about their abilities directly influence how much they can accomplish tasks outlined in their metacognitive plans. Teachers should recognize these factors and tailor their approaches to motivate students and accommodate their differences. It aligns with the findings of Acosta-Gonzaga and Ramirez-Arellano (2021), who emphasized that students are significant contributors to the development of metacognitive skills.

Discussion of the differences that arise when instructional models of work-based learning are used to improve students' metacognitive skills.

The relative development of students' metacognitive skills was assessed across three key dimensions: planning, monitoring, and evaluation. The data revealed that the work-based learning instructional model led to improvements in all three areas, with monitoring skills showing the most significant percentage increase. Post-test scores for each student indicated progress in all these domains, although the extent of improvement varied among them. It suggests that students may develop different facets of metacognition at varying rates. The findings support that a work-based learning model contributes to a comprehensive enhancement of metacognitive skills rather than focusing solely on one specific area. It aligns with the research by Shah & Modna (2022), who said that practical metacognitive skills should result in better planning, enhanced monitoring, and improved evaluation capabilities.

The work-based learning instructional model has been shown to enhance students' metacognitive skills overall. However, the extent of this improvement can vary due to individual differences. Factors such as prior educational background, attitudes toward learning, learning styles, and cognitive abilities can contribute to this variation. For instance, students who already possess solid metacognitive skills may see less dramatic improvements than those starting with a lower skill level. This observation aligns with the findings of Gutiérrez de Blume & Montoya Londoño (2021), who also noted significant individual differences in the development of metacognitive skills as follows: 1) The experimental results further elucidate how the work-based learning model enhances these skills. Specifically, the model restructures existing disciplinary knowledge into work-task-based learning, providing a more integrated and practical approach to skill development. The students' learning process is designed to focus on real-world work content, ensuring a smooth transition to their future careers, 2) The development of our instructional model was guided by

comprehensive research. We conducted interviews and questionnaires to identify the key factors influencing improving metacognitive skills in a work-based learning environment. Armed with this information, we customized the instructional model to address these factors specifically, 3) To ensure the model's efficacy and reliability, it was rigorously reviewed and verified by a panel of five professional scholars in the field, and 4) This study proposes an instructional model aimed at enhancing students' metacognitive skills through work-based learning. The model consists of four key elements: principles, objectives, learning process, and outcomes. The principles focus on integrating theory and practice, while the objectives clearly define metacognitive learning goals. A detailed five-step learning process is designed, and the expected outcome significantly improves metacognitive skills.

The five steps in the learning process based on this work-based instructional model are as follows:

(1) Introduction: The first step sets clear learning objectives, providing students with a roadmap for what they aim to achieve. It is a fundamental aspect of metacognitive planning skills.

(2) Teacher-Led Learning: In this step, tasks are collaboratively completed under the guidance of a teacher.

Students can monitor their understanding in real-time, compare it with their peers, and adjust their strategies accordingly, enhancing their metacognitive monitoring skills.

(3) Student Practical Exercises: Students apply what they have learned to real-world scenarios through actual cases. This step requires them to continuously evaluate and adjust their strategies based on outcomes, thereby exercising their metacognitive monitoring and evaluation skills.

Panel Discussion: This step provides students with different perspectives. They can identify gaps in their understanding and strategies by comparing their thought processes with their peers. Sharing experiences and insights further refines their metacognitive monitoring and assessment skills.

(4) Learning Review: Post-teaching assignments compel students to apply what they have learned, testing their understanding and strategies. Self-evaluation at this stage reinforces metacognitive assessment skills as students assess their performance and identify areas for improvement.

In summary, each learning process step is meticulously designed to target specific facets of metacognition. From planning and monitoring to assessment, students are continuously engaged in activities that foster the development of their metacognitive skills.

5. Conclusion

(1) Through interviews with teachers and questionnaires, the study found that the influencing factors of the work-based learning instructional model for improving metacognitive skills include students, teachers, the teaching process, and the environment, in which the learning process has the most significant influence, followed by environmental factors, followed by the teacher's factors. The last one is the student's factors.

(2) A work-based learning instructional model for improving metacognitive skills consists of four components, namely 1) principles, 2) objectives, 3) learning process, and 4) results.

(3) The t-test was used to determine if there was a significant difference between the student's metacognitive skills before and after implementing the work-based learning instructional model.

6. Future Research

(1) This research is a work-based learning instructional model to improve metacognitive skills, and future research could explore a variety of innovative approaches to developing metacognitive skills. It may include integrating virtual or augmented reality technologies to simulate real work scenarios to make learning more accessible and engaging.

(2) Current research uses metacognitive skills as the primary dependent variable. Still, future research could explore the impact of work-based learning instructional models on other dependent variables, including critical thinking and problem-solving skills.

(3) This study demonstrates that the work-based learning instructional model improves metacognitive skills and that there is still room for improvement and enhancement. Future research could focus on adjusting the learning process steps, incorporating additional resources, or modifying assessment criteria. Continually improving the instructional model will ensure that metacognitive skills are maximized.

(4) This research is based on students majoring in highway engineering supervision at Qinghai Communications Technical College. Future research could extend the application of the work-based learning instructional model to

other learner groups, such as students in different courses, students in different majors, adult learners, and professionals in continuing education.

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