

**MODELING STUDENTS' TECHNOLOGY,
COGNITIVE AND COTENT KNOWLEDGE (TSCCK) WITH A
CLOUD TO ENHANCE VOCATIONAL STUDENTS'
COGNITIVELOAD AND LEARNING ACHIEVEMENT**



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Thesis Title MODELING STUDENTS' TECHNOLOGY, COGNITIVE AND COTENT KNOWLEDGE (TSCCK) WITH A CLOUD TO ENHANCE VOCATIONAL STUDENTS' COGNITIVELOAD AND LEARNING ACHIEVEMENT

Student Name Mrs. Qiong Wu

Student ID 62603105

Degree Doctor of Philosophy

Program Technology-Enhanced Learning and Innovation
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Thesis Advisor Associate Professor Dr. Sirirat Petsangsri

Thesis Co-Advisor Assistant Professor Dr. Thanin Ratanaolarn

ABSTRACT

The application of scientific and technological approaches in education has been increasing year by year. Based on cognitive load theory, this study uses the TSCCK model with a cloud for vocational students to improve their cognitive load and learning achievement. There were 3 objectives ,1) to find the status of the Chinese Vocational students' technology, cognitive and content knowledge (TSCCK) with a cloud. 2) to develop the TSCCK model with a cloud to enhance the cognitive load and learning achievement of Chinese Vocational students, and 3) to find the effect of the TSCCK model on the cognitive load and learning achievement of Chinese Vocational students. To achieve these three objectives, firstly, we randomly selected 90 students from a total of 115 students majoring in E-commerce using simple random sampling to participate in the experiment. Questionnaire (5-point Likert scale) was used to find the current status of technology, cognitive, and content knowledge of vocational college students. Secondly, the TSCCK model was evaluated by five experts through a questionnaire (5-point Likert scale), the overall mean was 4.65, and the Standard Deviation was 0.52, experts agree with the core idea of the TSCCK model, under the evaluated TSCCK instruction model with a cloud for vocational students, 10 students were taught using the TSCCK model with a cloud; and they were assessed by E-commerce test with criteria of 80% and WP scale were under 28.1 point to 42.0 point at a low cognitive load level, the questionnaire showed a satisfactory level. Thirdly, we evaluated the effect of a TSCCK model based on the cognitive load theory on the cognitive load and learning achievement of vocational students: 62 vocational student were selected using cluster random sampling. A total of 31 students were taught with instructions based on the TSCCK model, while 31 students were taught with a traditional method. The instruments used included lesson plans for the TSCCK group developed using the cognitive load theory and the workload profile self-rating scale (WP scale) used to measure the student cognitive load for both groups. The students

who learned with TSCCK had significantly lower cognitive load (WP scale) scores than the students who learned with the traditional method, and their achievement scores were higher than a control group. The MANOVA confirmed that both the achievement scores and cognitive load measures from the two groups were significantly different at the 0.05 level.



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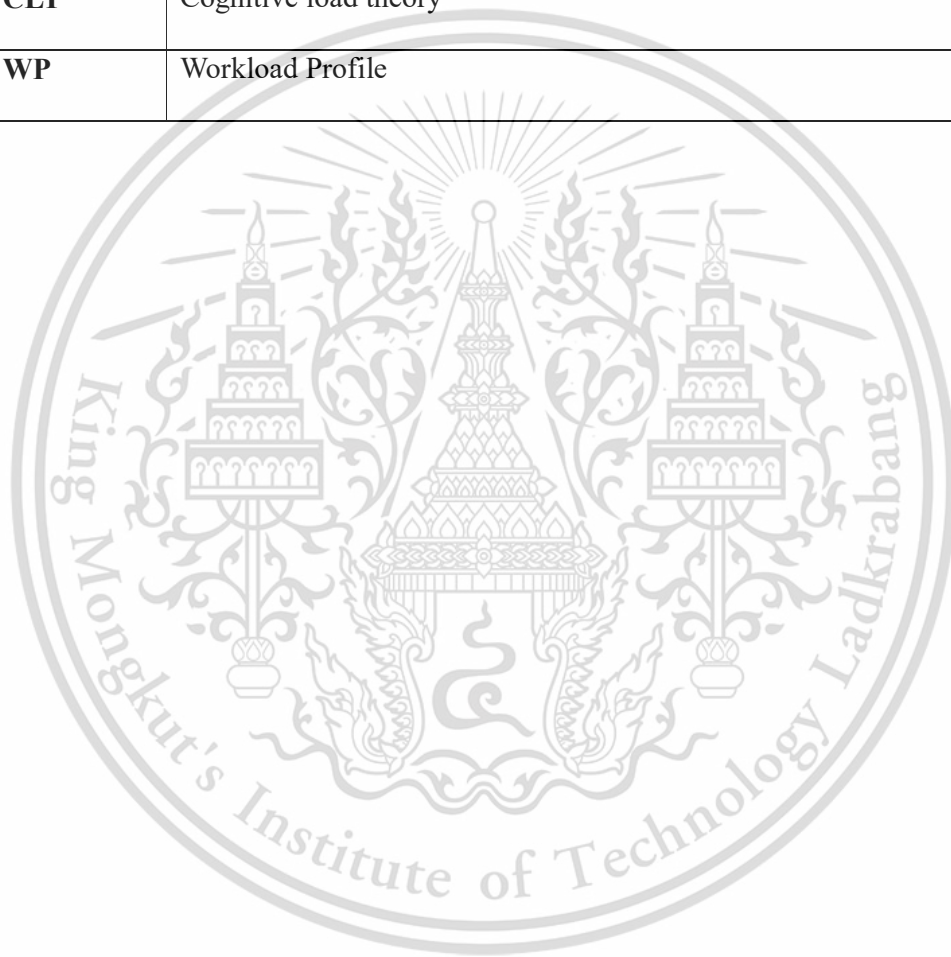
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LIST OF ABBREVIATION

TSCCK	Students Technology, Cognitive and Content Knowledge
SK	Student Content Knowledge
SCK	Student Cognitive Knowledge
STK	Student Technology Knowledge
CLT	Cognitive load theory
WP	Workload Profile



CHAPTER 1

INTRODUCTION

1.1 Background of the Study

Currently, the world is changing instantly every second in many aspects, among which most of them are driven by the use of "scientific and technological means", which greatly further facilitates human life and other innovative fields. The key to the continuous development of science is innovation and education brought by human cultivation. Also, the Chinese government and people recognized the issue. The comprehensive national strength, therefore, had greatly enhanced in just a few decades in education field, nowadays, lecturers are not only needed to master traditional teaching methods, but that would be great to integrate "modern information and technology" technique with variety of pedagogy. To achieve this goal, the government has done a lot of work.

First, in order to speed up the cultivation of modern information technology literacy, the Chinese government has employed this issue into the "Key Points of Work of the Ministry of Education in 2021 In China" releasing *Actively promote the construction of education informatization* document ("Key Work Points of the Ministry of Education in 2021", 2021). This document particularly emphasizes the use of informatization in education. What is "informatization in education"?

The document " Education Informatization 2.0 Action Plan" of the Ministry of Education of China indicates an educational concept of "Education Informatization "(Yan & Yang, 2021) as a comprehensively and deeply making use of modern information technology to promote educational reformation and development in the field of education.

In addition, Yan & Yang, (2021) describe Teaching Informatization (Industry Information Network, 2020; Souhu, 2019) as the application of scientific knowledge about intelligence and data management teaching in all aspects supporting an improvement of learning quality and efficiency.

Teaching informatization is the core of education Informatization. In the classroom, there are various types of materials for the teachers to employ; e.g. multimedia, networks, AI, etc.and other technologies to assist in teaching. For example, in history class, many magnificent ancient buildings are no longer existed at present, because of a long-time pass, since the instruction of ancient Chinese architecture, we can reproduce and experience the real historical scenes of that time through Multimedia, Internet, AI, and other technologies.

By creating teaching scenarios based on information technology, this approach can stimulate learners' enthusiasm and create a good atmosphere for learning supporting a better work for students. Moreover, these modern teaching technique and materials are now widely applied with the traditional teaching style.

In recent years, China's social and economic development was rapid, the urgent need for a large number of highly skilled personnel would be supported, for this reason, specialized training of skilled personnel in vocational colleges was increased in China. High vocational colleges, as an important part of China's high education, focused on cultivating technical application-oriented talents compare with general high education. The main characteristics of students in high vocational colleges in China are Active thinking, strong operational ability and Unclear learning

objectives, weak learning initiative and self-consciousness (Xu, 2014). The personality of each can be noticed by;

- Active thinking, strong operational ability

Compare with students in academic colleges and universities in China, students in vocational colleges often show more active thinking, stronger hands-on ability, and enthusiasm for participating in various activities despite their poor cultural foundation.

- Unclear learning objectives & weak learning initiative and self-consciousness

Because the academic performance of Chinese high vocational students in theoretical courses is lower than that of Chinese universities with academic talents, students' learning initiative and consciousness are weak. In this case, if teachers adopt the same teaching methods to high vocational students in learning activities as those used by universities to train academic talents, it is impossible to achieve the expected teaching goal -- training technical application-oriented talents.

Under these circumstances, how can teachers in high vocational colleges in China design learning activities to stimulate students' learning enthusiasm? How to train high-quality technical and skilled personnel to adapt to China's economic and social development? It is a difficult problem faced by teachers in high vocational colleges in China.

The vocational education cloud, is the construction and application platform of the master teaching resource base, was designed and established in accordance with the functional positioning of professionalization and the requirements of the education major teaching resource base on the Ministry of Education project: Manual for Construction of Professional Education Teaching Resource Base (Gao, 2020). Instructors, as the leader or activities designer can utilize the platform which is technically support and integrate various learning resources. The appropriate cloud application might help to reduce some on-site danger that hard to explain. after graduation, the scholar would be ready to get involve to the task immediately. Seemingly, the vocational education cloud is a very good online teaching platform.

This platform is based on the school, and each teacher has a corresponding account and power when use the platform for instruction. Specifically, it can be divided into three parts: before class, In class, and after class.

Before class, teachers can obtain the teaching information resources of the platform for free, and combine them according to their classroom teaching content.

In class, teachers use relevant resources and functions of the platform to conduct information-based teaching for students, such as checking-in, brainstorming, playing animation videos on the platform, etc.

After class, teachers can carry out relevant tests and assign homework, the system will automatically record students' learning trajectory.

However, since Vocational Education Cloud online teaching functions only be a technology, to fully integrate technology into education and make them play a better role, the guidance of cognitive load theory is required. Meanwhile, you have to reduce the intrinsic and extraneous cognitive load of students as far as possible to improve the germane cognitive load of students.

Cognitive load theory (Plass, Moreno, & Brünken, 2010) is a theory that promotes learning and teaching design based on the results of cognitive psychology about research, involving a wide range of application capabilities and operational value and showing a positive development prospect. The concept has gradually

become prominence in education and cognitive psychology, since its proposal in the 1980s, and also become the main theoretical framework for teaching and personalized learning design.

Cognitive load theory is one of the teaching design theories, as we know, Cognitive load theory holds that the main function of teaching is to store information in long-term memory. Knowledge is stored schematically in long-term memory. Schema organizes information according to the way information elements are used. It provides the mechanism of knowledge organization and storage, which can reduce the working memory load. As we all know, one of the ideas behind instructional design is the cognitive load hypothesis, which asserts that the primary goal of instruction is to help students retain knowledge. Long-term memory stores information schematically. The usage of information components determines how a schema organizes data. It offers a system for organizing and storing knowledge, which helps lighten the workload on the working memory.

As a result, education seeks to instill knowledge in students' long-term memory under the supervision of cognitive load theory. There are three types of cognitive load according to this idea. Intrinsic cognitive load first relates to the material's inherent difficulty, which can be guided by prior knowledge. Second, extraneous cognitive load is the load brought on by how the content is presented and how the instructional methodology is implemented. Third, long-term memory schema restoration is referred to as a relevant cognitive burden (Paas, Renkl, & Sweller, 2003). As a result, education seeks to instill knowledge in students' long-term memory under the supervision of cognitive load theory.

The 21st century is an information age. To absorb the necessary knowledge from the vast ocean of information quickly and efficiently is required by the times, and become the basic characteristic of modern learning, as well as the essential quality and pursuit of modern learners. With a wide range of application capabilities and operational value, applying cognitive theory would seem to guide the faster process for the next steps. The main purpose of my research on cognitive load is to investigate how to promote the cognitive load of students in the context of modern Information-based teaching with the TSCCK model (Student technology, Cognitive and Content knowledge model).

The TSCCK model is an instruction model which support high vocational students to develop their technological works, architecture, mechanics, art, electronics, etc. The model consisted of three parts: Students Technology Knowledge (STK), Students Cognitive Knowledge (SCK), Students Content Knowledge (SK).

Students Technology Knowledge (STK) is the key points in the TSCCK model, It accords with the learning objectives, more understanding intuitives, and practical, of high vocational colleges and the cognitive status of the students. As a teacher, if you grasp the STK, and combined with Vocational Education Cloud technology based on cognitive load theory, which will make learning activities more interesting, applying video, playing game, brain storming, etc. So the TSCCK model is suitable for the teaching of high vocational students in China.

It is not only necessary to adopt an appropriate teaching design to support students and reduce students' extraneous cognitive load and intrinsic cognitive load (Plass, Moreno, & Brünken, 2010), but also enable students to learn how to use germane cognitive load and metacognitive load. In the context of modern information technology, teachers should apply TSCCK model by vocational education cloud technology to strengthen the management of student cognitive load and efficient teaching, which will be of great theoretical and practical effect, and also improving

the efficiency and effectiveness of teaching.

1.2 Research questions

Based on Students' Technology Knowledge (STK), Students Cognitive Knowledge (SCK), Students Content Knowledge (SK), The research questions proposed are:

What is the status of the Chinese Vocational students' technology, cognitive and content knowledge (TSCCK) with a cloud?

What are the components of the TSCCK Model?

Are there any significant differences on cognitive load and learning achievement between students who learn with the TSCCK model with a cloud on E-commerce Data Analysis and Processing course and those who learn with traditional method?

1.3 Objectives of the study

(1) To find the status of the Chinese Vocational students' technology, cognitive and content knowledge (TSCCK) with a cloud.

(2) To develop the TSCCK model with a cloud to enhance the cognitive load and learning achievement of Chinese Vocational students.

(3) To find the effect of the TSCCK model on the cognitive load and learning achievement of Chinese Vocational students.

1.4 Statements of the hypothesis

The researcher hypotheses for the study is: Students who learned with TSCCK through a cloud on Fundamentals of E-commerce Data Analysis and Processing course would have lower cognitive load and higher learning achievement than students who learned with the traditional method.

1.5 Scope of the study

This study was focused on the development of the cloud with the TSCCK model based on cognitive load theory, aiming to reduce the cognitive load and enhance learning achievement of vocational students. The scope of this study is:

1.5.1 This research and development involve three phases as follows:

Phase 1: to find the status of the Chinese Vocational students' technology, cognitive load and content knowledge.

Phase 2: to develop the TSCCK model with a cloud for Chinese Vocational students.

Phase 3: to find the effect of the TSCCK model with a cloud for Chinese Vocational students.

1.5.2 The population, sample and source of data

Phase 1: to find the status of the Chinese Vocational students' technology, cognitive and content knowledge.

1) Study, analyze and synthesize cognitive load theory for the development of the TSCCK model, cloud and Gagné's Nine Events of Instruction.

Data source: 30 Research papers

Research Instruments: Record data form

Data analysis: Content analysis

2) Find the status of the Chinese Vocational students' technology, cognitive and content knowledge.

Data source: Ninety vocational students majoring in E-commerce were selected randomly, using simple random sampling, from a pool of 115 vocational students at Guizhou Vocational Technology College of Electronics & Information in China.

Research Instruments: Questionnaire

Data analysis: Mean and Standard Deviation

Phase 2: to develop the TSCCK model with a cloud for Chinese Vocational students.

Step 1: To develop, assess and evaluate the TSCCK with a cloud for Chinese Vocational students.

Data source: five experts in educational technology by a focus group interview

Research Instruments: Questionnaire and IOC form

Data analysis: Mean and Standard Deviation

Step 2: Find the efficiency of the TSCCK model with a cloud for Chinese Vocational students

Data source: 10 vocational students majoring in E-commerce

Research Instruments: TSCCK model with a cloud, lesson plans, cognitive load tools (WP scale), and E-commerce test

Data analysis: Criteria 80% for achievement test and cognitive load (WP scale) under 28.1 point to 42.0 point

Phase 3: to find the effect of the TSCCK model with a cloud for Chinese Vocational students.

Population: Details of the population and sample were set out in Table 1.1

Table 1.1 Details of population and sample

School Location	Kaili	107.99848° W, 26.58727° N
Name	GuiZhou Vocational Technology College of Electronics & Information	
Course	E-commerce data analysis and processing	
Duration	4 weeks	Second semester of the 2021-2022 academic year
Student age range	18 – 21 years	
Level	Second year	
Total population	115	
Sampling strategy	Select 62 students from 115 students using cluster random sampling	
Class size	Experimental (with TSCCK)	31 (4 female, 27 male)
	Traditional	31 (9 female, 22 male)

Sample: The first group included thirty-one Chinese students. The second group included thirty-one Chinese students. They all came from the same vocational college in China.

There were two types of variables in this study as follows:

Independent variable: TSCCK model with the cloud and a traditional method

Dependent variable: Students' cognitive load and learning achievement

The subjects were E-commerce Data Analysis and Processing

E-commerce Data Analysis and Processing mainly refer to letting the students systematically understand the basic concept of E-commerce operation, the basis of E-commerce data analysis and processing, familiar with E-commerce data analysis strategy, skilled use of the knowledge to complete the operation of E-commerce and can be familiar with and deal with aspects of the operation of E-commerce data analysis and processing related content., etc. "E-commerce Data Analysis and Processing " is a course combining theory with practice, and is suitable for students majoring in E-commerce in most of China's ordinary colleges and universities.

The implementation of the TSCCK model with a cloud lasted four weeks and it was conducted in the second semester of the 2021-2022 academic year.

1.6 Research framework

To better verify the hypothesis and the application of "cloud" technology in instruction can affect students' cognitive load and improve students' learning ability, I have referred to many professional books and related literature when writing this thesis. The university has offered the course "Handbook of Educational Communication and Technology Research" during the doctoral period. When learning the knowledge related to the ninth part "TPACK", I was inspired by the teacher's profound knowledge and high professional level and had access to more space for thinking. Based on the cognitive load theory, I designed the "Student Technology, Cognitive and Content Knowledge Framework", that is, the "TSCCK" model.

To let the TSCCK model can play its due role in teaching, I integrated "problem-based learning", "project-based learning" and other teaching methods by virtue of "cloud " technology, cognitive load theory, Bloom taxonomy and other theoretical knowledge. In this way, student technical knowledge (STK), student content knowledge (SK) and student cognitive knowledge (SCK) were closely linked together, and the framework of "Student technology, Cognitive and Content knowledge" based on "cloud" technology was established. It is hoped that this information technology can facilitate significantly improve students' cognitive load and learning ability (Figure1.1).

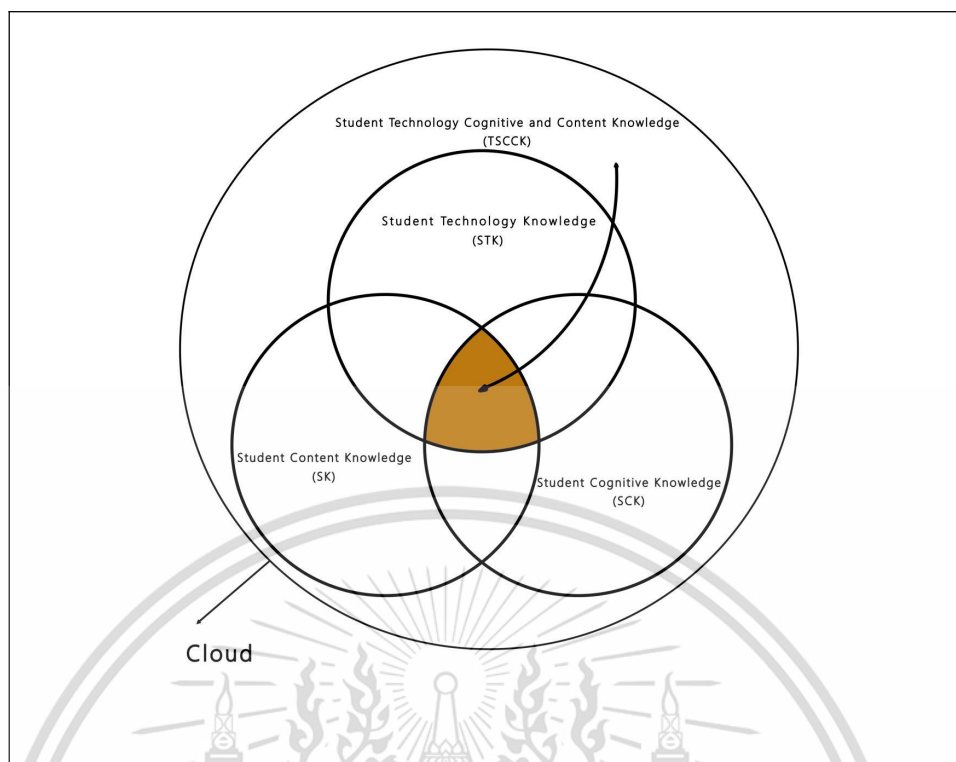


Figure 1.1 TSCCK model

This chart was adapted from the Handbook of Research on Educational Communications and Technology (Spector, Merrill, Elen, & Bishop, 2014), Part 9: The Technological Pedagogical Content Knowledge Framework (TPACK), which is concerned about constructing teachers' knowledge framework of technology content. Therefore, inspired readily this framework, I modified it:

Firstly, The Technological Pedagogical Content Knowledge (TPACK) to Student Technology knowledge, Cognitive knowledge, and Content Knowledge (TSCCK);

Secondly, Technological Knowledge (TK) to Students Technology Knowledge (STK);

Thirdly, Pedagogical Knowledge (PK) to Students Content Knowledge (SK);

Fourthly, Content Knowledge (CK) to Students Cognitive Knowledge (SCK);

Fifth, Contexts to Cloud.

Then I created the framework of the "Student technology, Cognitive and Content Knowledge (TSCCK) model. I will explain how this framework promotes students' relevant cognition and learning achievement in the next part.

Student Content knowledge (SK) refers to any subject-related knowledge that a student should learn.

Student Cognitive knowledge (SCK) refers to the concept of cognitive load involved in cognitive load theory and how teachers should adopt appropriate instruction design to promote students' learning.

Student Technology knowledge (STK) refers to students' knowledge of traditional and new technologies that can be integrated into learning.

Three components in the TSCCK framework address the issue of how these three knowledge systems interact, constrain, and supplement each other.

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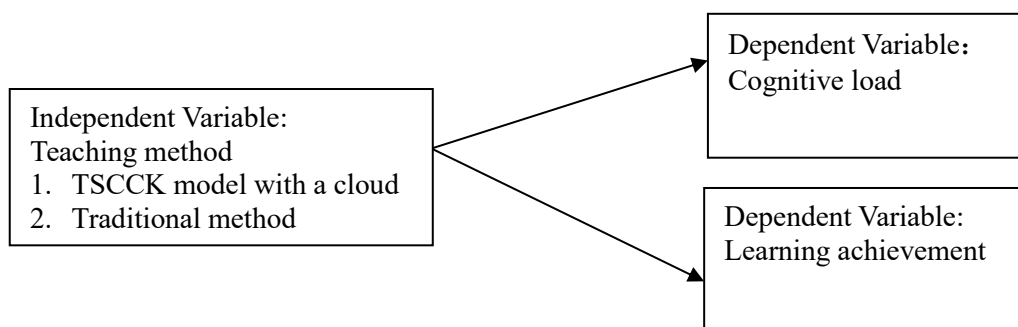


Figure 1.2 Research framework

Independent variable: Teaching method which as follow:

1. TSCCK model with a cloud
2. Traditional method

Dependent variable: Students' cognitive load and learning achievement

1.7 Definition of terms

Vocational Education Cloud is an online teaching platform for teachers and students in schools. Teachers can directly import the courses (materials or topics) from the national resource platform -- wisdom vocational education into the vocational education cloud to carry out teaching. It creates a growth channel for students from campus to society. In addition, through the mobile APP "Cloud Classroom Wisdom Vocational Education", teachers can grasp students' real-time trends and carry out variety classroom activities with students through the APP. It is call cloud for short in this paper.

Student Content knowledge (SK) refers to any subject-related knowledge that a student should learn.

Student Cognitive knowledge (SCK) refers to the concept of cognitive load involved in cognitive load theory and how teachers should adopt appropriate instruction design to promote students' learning.

Student Technology knowledge (STK) refers to students' knowledge of traditional and new technologies that can be integrated into learning.

Cognitive load theory is designed to provide guidelines, aiming to assist in the presentation of information in a manner that encourages learner's activities and optimizes intellectual performance (Sweller, van Merriënboer, & Paas, 1998).

Cognitive load refers to the used amount of working memory resources. Cognitive load theory differentiates cognitive load into three types: intrinsic, extraneous, and germane.

Intrinsic cognitive load is the effort related to a specific topic.

Extraneous cognitive load refers to the way in which information or tasks are presented to a learner. For this study, I focus on extraneous cognitive load.

Germane cognitive load refers to the work devoted to creating a permanent store of knowledge, or a schema (Miller, 1956).

Student cognitive load refers to the seven dimensions of resources that students used to learn a particular content. For this study, WP scale was used to evaluate the consumption of cognitive load.

Learning achievement refers to the "level of student success in learning the subject matter in schools that are expressed in the form of scores obtained from the results of tests

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

It is a strategic choice for China's educational reformation and development to promote the scientificization, informatization and modernization of learning process of information technology based on computer, multimedia and network communication in the educational process in order to cultivate talents to meet the new requirements of the information-oriented society, and to promote the modernization of education using information technology.

"Key Points of Work of the Ministry of Education in 2021 In China": Actively promote the construction of educational informatization. ("Key work points of the ministry of education in 2021", 2021). The Chinese government will fully implement the action plan for informatization 2.0 in education, accelerate the construction of private education networks, and popularize the construction and application of digital campuses.

They have issued guidelines on strengthening the development and application of online education and teaching resources for primary and secondary schools, improving the national public service system for digital education resources, and establishing an online cloud platform for primary and secondary schools. They will deepen the campaign to popularize the application of online learning space, and comprehensively enhance the information literacy of teachers and students.

In the context of continuously strengthening the construction and development of educational informatization, provinces, cities, regions and universities in China have successively formulated the "13th five-year" development plan of educational informatization to promote the efficient development of educational informatization.

Students are the direct beneficiaries of the informatization teaching, and teachers play a leading role in the information technology teaching.

2.2 Theory-based Education and Technology Education

2.2.1 Information technology

Information technology (IT) refers to using computers to store, retrieve, transmit, and manipulate data (Daintith, 2009) or information. IT, neither personal nor entertainment technology, is generally used for business operations ("Free on-line dictionary of computing (FOLDOC)", 2013) and is considered as a subset of information and communications technology (ICT). Information technology systems (IT systems) usually refer to information systems, communication systems, or more specifically computer systems operated by a certain group of IT users, including all hardware, software, and peripherals.

Since the Sumerians of Mesopotamia invented writing in 3000 BC, humans have been storing, retrieving, manipulating, and exchanging information (Butler, 2012). However, the term information technology in the modern sense appeared initially in an article published in Harvard Business Review in 1958; authors Harold J. Levitt and Thomas L. Whiss Le commented: "This new technology, not yet given a fixed name, can be called information technology (IT)." It is divided into three categories: processing technology, the applications of statistical and mathematical

methods in decision-making, and computer program-stimulated higher-order thinking (Leavitt & Whisles, 1958).

This term is often used as a synonym for computers and computer networks, which also includes other information distribution technologies, such as television and telephone. Some products and services in the economy are related to information technology, including computer hardware, software, electronic products, semiconductors, the Internet, telecommunications equipment, and E-commerce (Chandler & Munday, 2011).

According to the storage and processing technology used, its development may undergo four different stages: pre-mechanical stage (3000 BC-1450 AD), mechanical stage (1450-1840), mechanical (1840-1940) Year, and electronic stage (1940-present) (Butler, 2012). This study is focused on the most recent stage - electronics.

2.2.2 Cognitive load theory

Cognitive load

According to cognitive psychology, **cognitive load** refers to the use of working memory resources, which can be divided into three types: intrinsic cognitive load refers to the effort related to a specific topic, extraneous cognitive load refers to the way in which information or tasks are presented to learners, and germane cognitive load refers to the work devoted to creating a permanent knowledge reserve Schema (Miller, 1956).

Cognitive load theory was proposed in the problem-solving research (Sweller, 1988), which believed that instructional design could be used to reduce the cognitive load of learners. Soon after that, other researchers developed a method to measure perceived mental effort, known as an indicator of cognitive load (Paas & Van Merriënboer, 1993).

The pupil response to task stimuli is a reliable and sensitive measure of cognitive load, which is directly related to working memory (Granholm, Asarnow, Sarkin, & Dykes, 1996).

Information is stored in long-term memory only after being processed in working memory. However, the capacity and duration of working memory are very limited, which may hinder learning. A heavy cognitive load will have a negative impact on task completion. It should be noted that an individual's experience of the cognitive load varies.

The basic principle of cognitive load theory lies in that if more consideration is given to the role and limitations of working memory, the quality of instructional design will be improved. Due to distraction, especially when using mobile phones, students are more likely to experience a high cognitive load, which will reduce their academic performance (Frein, Jones, & Gerow, 2013).

Theory

"Cognitive load theory is designed to provide guidelines and information in a way that encourages learners to engage in activities that optimize intellectual performance." (Sweller, Van Merriënboer, & Paas, 1998). Sweller's theory emphasized the inherent limitation of concurrent working memory load on learning in teaching by adopting various aspects information processing theory. Schema (Miller, 1956) is used as the main analysis unit of teaching material design.

Measurement

Sweller, Paas and Van Merriënboer (1998) developed a structure (called relative conditional efficiency) aiming to help researchers measure perceived mental effort, which is an index of cognitive load. This structure provided a relatively simple

method for comparing teaching conditions and integrated mental effort score with performance score. The group mean z-score was shown graphically and can be compared with a one-way analysis of variance (ANOVA).

Ergonomics methods have been used to seek quantitative neurophysiological expression of cognitive load, which can be measured using common instruments, such as heart rate-blood pressure products (RPP) to measure cognitive and physical load (Paas, Tuovinen, Tabbers, & van Gerven, 2003). It is believed that RPP measures may be used to set workload limits and establish work allowance.

The pupil's response to task arousal was a measure that directly reflects the cognitive load of working memory. It was found that larger pupil dilation is correlated with high cognitive load (Leavitt & Whisles, 1958). The pupil's response triggered by the task is directly related to working memory making it as effective measure of cognitive load that is obviously correlated with learning.

Some researchers have compared different measurement methods of cognitive load (Skulmowski & Rey, 2017). For example, Deleeuw and Mayer (2008) compared three commonly used cognitive load measurement methods and found that they responded differently to extraneous load, intrinsic load, and germane load respectively. Recently, Skulmowski and Rey (2020) showed that there are different demand components that jointly form an additional cognitive load which requires further measurement using different questionnaires.

The established cognitive load eye movement and pupil response indicators are (Buettner, 2013):

Meaning of pupil diameter

- Deviation of pupil diameter
- Sweep speed
- Pupil iris tremor (Buettner, 2014)

Tina ("Free on-line dictionary of computing (FOLDOC)", 2013) analyzed the affordances in different phases of self-regulated learning in terms of intrinsic load, extraneous load and germane load. In conclusion, the interplay between different affordances of self-regulation and resources and aptitudes of learners is described in an integrated model of self-regulation and cognitive load (Seufert, 2018).

Shehab and Nussbaum (2015) compared the cognitive load of two critical thinking strategies related to argument integration. They claimed: (a) to minimize the disadvantages of an alternative in constructing design and (b) to weigh refutations weaken an argument by arguing that there are more important values at stake.

Paas et al. (2003) have pointed out that the subjective rating scale was issued in many different ways than that originally suggested by Paas and Van Merriënboer (1994a, 1994b). Among other differences, researchers have used different verbal labels: i.e. 'task difficulty' instead of 'invested mental effort', fewer categories; e.g. five or seven instead of nine or merely used one measurement after all learning or testing tasks, rather than an average of multiple measurements after each learning and testing task.

However, the first two examples would require further studies on the psychometric properties of the adapted rating scales, and the latter has been further investigated by Schmeck et al. (2015). They used an average score to compare the original way of measuring load based on multiple measurements after each learning and testing task by means of an adapted approach using only one measurement after the learning phase and one after the testing phase. The question was whether this would lead to a different estimate of the magnitude of cognitive load. Results showed that the one measurement after the instruction or testing phase was always higher than

the average of multiple measurements during the learning or testing phase. Despite the exact reason for the difference remaining unknown, the higher single score after the learning or testing phase could suggest a depletion of working memory resources (Chen, Castro-Alonso, Paas, & Sweller, 2018).

The second advancement extends to the subjective technical aspect, mainly referring to the design of questionnaires capability of distinguishing between different types of cognitive load. Ayres (2006) measured the changes in a specific type of cognitive load, whereas Cierniak, Scheiter and Gerjets (2009) studied methods of different cognitive loads measurement. Leppink et al. (2013, 2014) investigating the effectiveness of a new psychometric tool and represented different types of cognitive load using different indicators. Sweller et al. (Sweller, van Merriënboer, & Paas, 2019) verified the hypothesis that their 10-item psychometric tools could be used to distinguish intrinsic cognitive load from the extrinsic cognitive load.

The third advancement was in continuing efforts to discover more objective measurements of cognitive load. Studies suggest that the cognitive load imposed by first-level tasks can be measured by second-level task techniques (e.g., second-level task performance). Park and Brunken (2015) developed a rhythmic approach to secondary tasks involving rhythmic stomping. Korbach, Brünken and Park (2017) suggested that this technique is susceptible to hypothetical differences in cognitive load among three groups (mental animation group, alluring detail group, and control group).

2.2.3 WP scale

The workload profile scale is a tool used to assess the workload of an individual based on various factors such as physical demands, mental demands, emotional demands, and environmental demands. The scale typically ranges from low to high workload intensity, with each level being described in terms of the demands placed on the individual. The purpose of the workload profile scale was to identify the level of workload that an individual can handle and to ensure that workload was distributed appropriately to avoid burnout and fatigue.

The workload scale was contrasted with the Bedford Scale and the Psychophysical Scale as a novel multi-dimensional subjective workload assessment instrument by Tsang and Velazquez (1996). Participants took part in two distinct (single task) parallel laboratory exercises (dual task). In terms of task requirements, performance concurrent validity, and retest reliability, multi-dimensional processes are superior to single-dimensional processes. The canonical analysis's findings demonstrated that the multidimensional rating offers diagnostic data on the type of work needs. Also, the diagnostic data agreed with the characteristics of the earlier tasks. Given that individuals were able to describe pressures on many workload dimensions, this lends significant support to the idea that psychological workload was multi-dimensional. Longo and Orrú (2022) investigated the validity, sensitivity, and reliability of the self-reported mental workload measurement method of workload Profile applied to extended study periods in a typical university classroom by comparing the cross-learning teaching method and the multi-tasking teaching method, as well as combining pertinent theories and measurement techniques of these two fields. The evaluation of the two instructional environments was what these metrics were meant to support. The proof indicated the dependability of these particular procedures.

2.2.4 Bloom Taxonomy

Bloom classification is a rank order of cognitive skills, which can help teachers to teach and students to learn among other countless uses.

Revisions of Bloom's taxonomy

Founded by Benjamin Bloom (Anderson et al., 2001) in 1956, "Bloom's Taxonomy" was published as a classification method for the study of outcomes and goals. For more than half a century, it has been used for designing digital tasks and evaluating applications in written questions and evaluations.

In 2001, the framework of Lorin Anderson and David Krathwohl was revised, resulting in a revised Bloom's taxonomy, known as the most important in the field of cognition. The revision is cut "synthesis" off and adding "creation" in, the task pinnacle of hierarchy type of a stage. This new revision introduced a key change to the cognitive domain. Bloom's classification has changed the hierarchy type of language usage from nouns to verbs, thereby shifting attention from acquisition and participation in each stage to active performance learning.

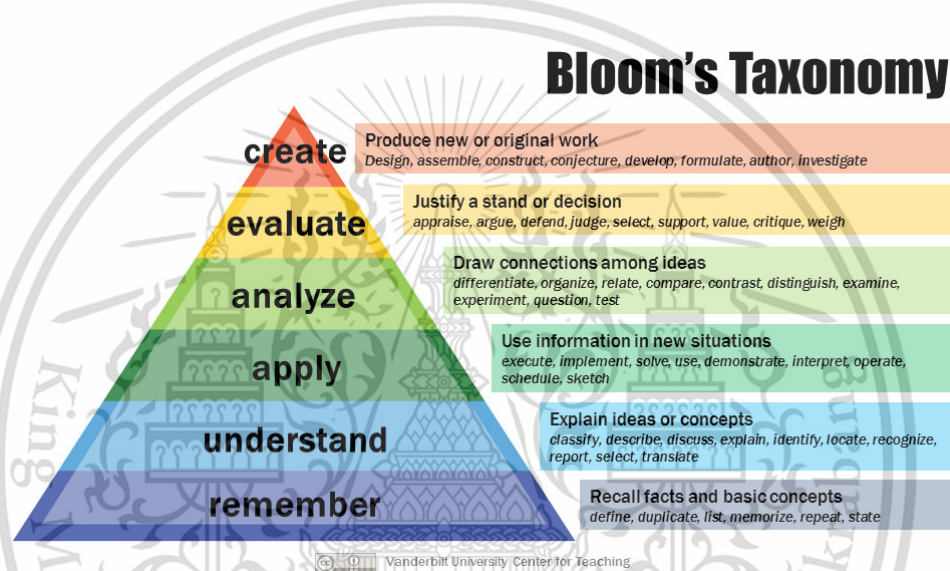


Figure 2.1 Revised Bloom's Taxonomy (Anderson et al., 2001)

Six levels of Bloom's classification

(1) To remember.

Examples of remember-level activities: to recall a song, to define the capital of each country in the world, or to memorize the mantras.

(2) To understand.

Examples of understand-level activity: Organize animals according to a given framework, explain the difference between an ellipse and a parallelogram, and summarize a simple storyline.

(3) To apply.

Apply-level examples: Use mathematical formulas to solve practical problems and use EXCEL tables to make performance rankings.

(4) To analyze.

The analysis-level examples: determine the "parts" of democracy; how the steps in the process work together, or determine why the machine cannot work.

(5) To evaluate.

The evaluate-level examples: explain the relative value of technological innovation in a specific environment, evaluate the decisions of the characters in the play and support your evaluation with text reports.

(6) To create.

The create-level examples: use the plot of a novel or create a short story in a new environment.

Bloom's Taxonomy is a model that suitable for teaching and learning, by which teachers can encourage students to gradually transition from low-level learning to high-level learning precisely because it refers to the six learning of Bloom's taxonomy steps.

2.2.5 Test Blueprint

A test blueprint is a detailed plan or outline that identifies the learning objectives, content areas, and skills that will be assessed in a test or assessment. It provides a framework for designing a valid and reliable test that measures the knowledge, skills, and abilities that are important for the test takers to possess.

The blueprint outlines the purpose and objectives of the test, the type of questions to be used, the content to be covered, and the level of difficulty for each question. It also defines the scoring and feedback system to be used and provides guidelines for test administration and security.

A well-designed test blueprint ensures that the test is aligned with the learning objectives, accurately measures the intended skills and knowledge, and provides useful feedback to test takers. It also helps test administrators and educators to identify areas where students may need additional instruction or support.

Overall, a test blueprint is an essential component of the assessment process, providing a clear and comprehensive plan for creating a valid and reliable test that accurately measures the intended learning outcomes.

Creating a test blueprint requires careful planning and consideration of various factors. Here are some steps to follow when creating a test blueprint:

Determine the purpose of the test: Identify the intended audience, learning objectives, and the specific knowledge, skills, or abilities that will be assessed.

Define the content areas: Identify the topics, concepts, and skills that will be assessed in the test. These should be aligned with the learning objectives and should cover the key content areas that are important for the test takers to know.

Determine the format of the test: Decide on the type of questions to be used, such as multiple-choice, essay-based, or a combination of both. Consider the time allowed for the test, the number of questions, and the difficulty level.

Establish the weighting of the test: Assign weightings to each content area based on the importance of the topic or skill to the overall learning objectives. This ensures that each area is appropriately represented in the test.

Develop the test items: Create a pool of test items for each content area, ensuring that they are aligned with the learning objectives and appropriate for the test format. Test items should be valid, reliable, and measure the intended knowledge, skills, or abilities.

By following these steps, you can create a comprehensive test blueprint that outlines the purpose, content, format, scoring, and administration of the test. This ensures that the test accurately measures the intended learning outcomes and provides useful feedback to test takers.

Table 2.1 Test blueprint

Instructional Objective	Test Question	Receiving	Responding	Affective		Characterization by Value or Value Complex
				Valuing	Organization	
After hearing experts debate a topic in a video provided by the teacher, the student will objectively summarize the viewpoint of each participant.	After watching a video excerpt (during which you may take notes) of a televised debate among experts, let discuss the U.S.'s presence in Iraq, list each expert and objectively summarize his or her views on the topic.		√			
Following class discussion of several workplace scenarios, the student will list 3 criteria that he/she will look for in a future workplace environment and explain why he/she values those characteristics.	Read the following list of 10 behaviours that you might encounter from coworkers or supervisors at a future place of employment. Choose the best 3 that represent the kind of workplace where you would enjoy working and write a paragraph explaining why you chose them.				√	
Given 3 classroom rules for showing respect (to the teacher, to classmates, and to property), the student will demonstrate respectful behaviour during an observation period of 5 consecutive days.	Now that we have discussed respectation and how to show it in this classroom, I will observe your behaviour each day this week and rate it using the chart below. Each day you will rate your own behaviour on a similar chart kept in your desk. In Friday afternoon, we would compare charts and reflect on how respectful your behaviour has been during the week.					√

Table 2.1 (Continued)

Instructional Objective	Test Question	Knowl edge	Cognitive Domain				Evalu ation
			Compr ehen sion	Appli ca tion	Analy sis	Synth esis	
From memory, the students will identify the 50 American states with 100% accuracy.	List the 50 states of the United States of America.	√					
Given an everyday problem to solve, the student will apply an appropriate mathematical formula to create a workable solution.	Study the house floor plan in the diagram below, imagine that you intend to buy new floor covering for all three bedrooms. Using the given dimensions calculate the total carpet size in square yards that you would need to cover the floors in those three rooms.			√			
Referring to a chart of the steps of the scientific method, the student will read a report on a scientific study and describe the parts of the study in terms of the scientific method.	Read the following summary of an experimental summary about Bacteria studying conducted by scientists, the chart below lists each step of the scientific method. Beside each label, write a sentence explaining the experiment represents which step of the scientific method. If you find that the scientists have not followed a particular step, take your note.				√		
Using resource materials, the student will critique a literary work according to standards of artistic quality, using at least three standards in his/her judgment.	Evaluate the novel read, evaluate the standard-quality the author made Refer to at least three of the standards listed on pp. 125-127 of our literature book and provide examples from the novel to prove each of your points.						√

Table 2.1 (Continued)

Instructional Objective	Test Question	Perception	Set	Psychomotor Domain				
				Guided Response	Mechanism	Complex Overt Response	Adaptation	Originality
Given access to an out-of-tune guitar and an in-tune piano, the student will adjust the tuning pegs and, afterwards, demonstrate that the guitar plays in tune with the piano.	Show that you can tune a guitar by doing so, using the out-of-tune guitar and in-tune piano provided. When you are done, play each string of the guitar followed by its corresponding note on the piano to demonstrate their being in tune with one another.	√						
Using a table saw, the student will change one blade for another, remove and then replace the blade guard, and turn the saw on and off following standard safety precautions.	Follow the safety procedures demonstrated yesterday for using a table saw, show me that you can change, remove and replace the blade guard, and turn the saw on and off.			√				
Following a 10-minute warm-up period, the student will take no more than 5 minutes to shoot one right-handed layup, one left-handed layup, one free throw, and one three-point jump shot on the first attempt for each.	To show your proficiency at shooting the basketball, demonstrate the following shots in only one attempt each: a right-handed layup, a left-handed layup, a free throw, and a three-point jump shot. You will have 5 minutes maximum to complete all 4 shots. You will have 10 minutes to warm up and practice.						√	
Drawing upon standard square dancing steps learned in class, the student will choreograph an original routine including at least 5 steps and then teach it to and perform it with 3 classmates.	Choreograph an original square dancing routine, which includes at least 5 of the standard steps that you learned in class. On Wednesday, you will teach 3 people in your group and 4 of you should perform to the class on Friday.							√

2.2.6 The Vocational Educational Cloud

The vocational educational cloud, the construction and application platform of a professional teaching resource database, is a function-oriented teaching resource database project of the vocational education section of the Ministry of Education of China. It is also in accordance with the requirements of the teaching resource database construction manual of that section (Gao, 2020), as well as the integrated design of structured course resources. The professional teaching resource database is an online teaching platform for teachers and students based on the school.

Teachers can directly import the courses (materials or topics) into the national vocational educational resource cloud platform. For example, teachers can input the content of lectures on the cloud, as shown in figure 2.2.

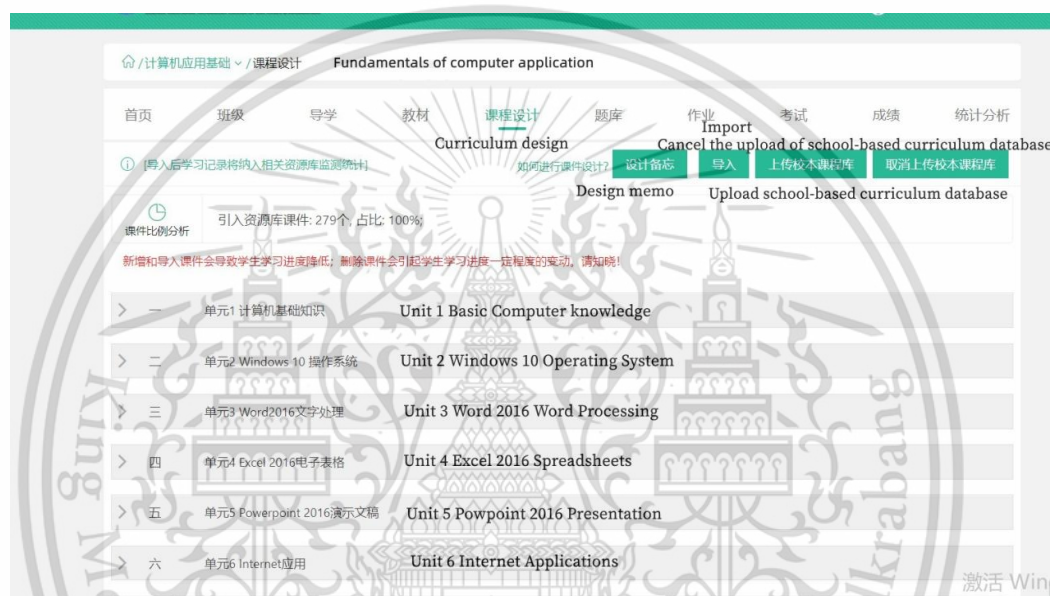


Figure 2.2 The teaching content

Using the mobile app (application) [Cloud Classroom Wisdom Vocational Education], teachers can grasp students' dynamics in real-time and can also carry out exciting classroom activities among students using the app. For example, students log on to the vocational education cloud via mobile phones or computers, where they can complete relevant tasks assigned by teachers, such as checking attendance and participating in Q&A, etc. At the same time, teachers can see students progress through the background system.

Students can accomplish a series of course requirements through app (application), such as submitting homework and exams.

Not only help teachers to play the leading role in guiding, inspiring and monitoring the teaching process, but it also fully reflects the initiative, enthusiasm and creativity of students as the main body of the learning process. Its concrete construction and applications are summarized in the following three points:

Resource pooling:

It responding to the requirement of the Ministry of Education vocational education professional teaching resource database project. It should complete the acceptance of the public platform of the national professional teaching database (or

online open courses). This can maximize the use of national repository of existing construction achievements, and promotes the construction of high-quality digital curriculum resources for colleges and universities, which providing more choices and greater significance in planning platform carrier material support and resources.

Online learning:

Teachers, students and authorized social learning personnel of the university can get access to the above resources with free of charge. Moreover, all of them can enjoy the operations of online open courses: MOOC (Massive Open Online Course), SPOC (Small Private Online Course), O2O teaching (Online and offline teaching), and mobile classroom learning services, in the exclusive teaching resource pool of school-based majors of the college.

Building a curriculum system for smart classrooms:

Construction of courseware

Teachers can enter the space through the operating system of the vocational education cloud by register and log in the personal information with the given account number and password, and construct course-related content in the course centre, such as 158 national vocational education professional teaching resources databases, more than 9000 standardized courses, and more than 1200 vocational education MOOC (Massive Open Online Course) available on the vocational education platform, which can solve the problem, of course, resources teachers need from the source (Li, Mao, & Yang, 2017).

Moreover, teachers can set up a test database in advance, so that students can be tested at any time according to their needs in class. Teachers can establish various courses on the Cloud according to the teaching plan, such as "Computer Foundation", "Data Analysis and Processing" and other courses (Figure 2.3); Pre-design and import the courses of the whole semester into the cloud platform (Figure 2.4); Set up practice database for students in advance (Figure 2.5).



Figure 2.3 Curriculum name

Figure 2.4 Curriculum design

序号	题干	题型	难度	知识点	创建时间	排序	来源	操作
1	计算机病毒的危害表现为影响程序运行, 破坏计算机系统的数据库与程序	判断题(客观)	简单	计算机病毒及其防治	2020-11-15 21:49:31	529	excel导入	查看 禁用 编辑 删除
2	计算机病毒会导致所有计算机操作人员感染疾病	判断题(客观)	简单	计算机病毒及其防治	2020-11-15 21:49:31	528	excel导入	查看 禁用 编辑 删除
3	下列关于计算机病毒的叙述中, 错误的是	多选题(客观)	简单	计算机病毒及其防治	2020-11-15 21:49:31	527	excel导入	查看 禁用 编辑 删除
4	下列关于计算机病毒的叙述中, 正确的是	多选题(客观)	简单	计算机病毒及其防治	2020-11-15 21:49:31	526	excel导入	查看 禁用 编辑 删除

Figure 2.5 The question database design

To open class, the teacher enters the Teacher Space, then logs on to Teachers Course, clicks the "Add Course" button, fills in the relevant course information in the Pop-up Window, and then clicks "OK" to complete the addition. In the new course, Relevant Class Information section, the teacher clicks the Relevant Class Information to add students in the resource library to the class for teaching. (Figure 2.6 Class Information)

Class ID	Class type	semester	Class size
42006	本校班级	2020秋	46
42010	本校班级	2020秋	44
42008	本校班级	2020秋	43
42009	本校班级	2020秋	42

Figure 2.6 Class information

The classroom instruction

It includes the introduction of classroom teaching activities, import of courseware, release and sign-in, new questions, new discussion, a new test, new vote, the introduction of the work, the introduction of the exam, the introduction of team PK (Player Killer), brainstorming, and new questionnaire link into classroom teaching. The teacher can click on the introduction of activities to choose the page and select activities according to the semester class and then check the required activity.

In the process of course building on the vocational education cloud, it provides rich resources and screens out useful, interesting and challenging content for students. The content will be shown in the form of links, videos, courseware, documents and resource packages. Additionally, they are relevant and attractive to students that conducive to improving the curriculum quality and skills development. Under some circumstances, it may be necessary to increase learners' motivation, and encourage them to employ learning processes that yield germane cognitive load (Gao, 2020).

Next, we will take the first course of Basic Computer Application as an example to illustrate how to integrate Student Content Knowledge (SCK), Student Cognitive Knowledge (SCK), and Student Technology Knowledge (STK) incorporating with changes of the three causes in students' learning ability.

Instructional Design

Since most of the content of this course get involves with the basic operation of computer knowledge, taking the simple lecturing method may not be interesting enough to attract most students to participate in the specific operation.

Therefore, to achieve the purposes of this course study, Teacher is going to use the problem-based goal-oriented method to give priority to collaborative learning activities.

Course content and requirements

Firstly, the design and relationship of various elements in the framework of problem-oriented cooperative learning activities are explained in detail by taking program design to solve practical working problems with Excel software as an example. (Table 2.2)

Table 2.2 Teaching content and standards

Learning Theme	Design and solve practical work problems by using Excel software																																																																																																																																																																																																																																																																																																																																													
Collaborative Learning Tasks (Students)	At present, the spreadsheet software has been widely used in work, such as school student status management, financial accounting, etc.																																																																																																																																																																																																																																																																																																																																													
Requirements for students	<p>Complete the task, assigned by the group leader, in groups. The quantity and difficulty of the tasks would be varied.</p> <table border="1" style="margin-left: 20px;"> <thead> <tr> <th colspan="9">Grade sheet for the first semester of Mechanical Class 0801</th> </tr> <tr> <th>Student ID</th> <th>Name</th> <th>Birth date</th> <th>English</th> <th>Mathematics</th> <th>Chinese</th> <th>Computer</th> <th>Scores</th> <th>Ranking</th> </tr> </thead> <tbody> <tr><td>98091</td><td>李丽丽</td><td>1989.9.30</td><td>19</td><td>60</td><td>70</td><td>71</td><td>220</td><td>10</td></tr> <tr><td>98092</td><td>赵瑾</td><td>1989.10.1</td><td>56</td><td>73</td><td>81</td><td>92</td><td>302.0</td><td>8</td></tr> <tr><td>98093</td><td>高玉明</td><td>1987.4.28</td><td>65</td><td>76</td><td>88</td><td>83</td><td>311.0</td><td>7</td></tr> <tr><td>98094</td><td>张芳丽</td><td>1988.12.6</td><td>66</td><td>89</td><td>97</td><td>74</td><td>326.0</td><td>5</td></tr> 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score</td><td></td><td>19</td><td>49</td><td>47</td><td>56</td><td></td><td></td></tr> </tbody> </table> <p>Task 1: Generate a student score table, use the sum function to calculate the total score of each student, use the rank function to rank according to the total score, and use the average Max min function to calculate the highest and lowest average scores for each subject respectively.</p> <table border="1" style="margin-left: 20px;"> <thead> <tr> <th colspan="9">Grade sheet for the first semester of Mechanical Class 0801</th> </tr> <tr> <th>Student ID</th> <th>Name</th> <th>Birth date</th> <th>English</th> <th>Mathematics</th> <th>Chinese</th> <th>Computer</th> <th>Scores</th> <th>Ranking</th> </tr> </thead> <tbody> <tr><td>98091</td><td>李丽丽</td><td>1989.9.30</td><td>19</td><td>60</td><td>70</td><td>71</td><td>220</td><td>10</td></tr> <tr><td>98092</td><td>赵瑾</td><td>1989.10.1</td><td>56</td><td>73</td><td>81</td><td>92</td><td>302.0</td><td>8</td></tr> 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Learning Theme	Design and solve practical work problems by using Excel software																														
	<p>Task 4: Generate a grade table for each subject. Statistically analyze the scores in the table, and use the nested use of the IF function to convert the scores into grades: 90 or above: excellent, 80-90: good, 70-79: medium, 60-69: pass, 60 or below: fail.</p> <div data-bbox="483 384 1305 919" style="text-align: center;"> <p>The chart, titled 'Performance statistical analysis chart', displays the number of students (人数) across five score segments (分数段) for four subjects. The subjects are: University English (blue), Advanced mathematics (red), University Chinese (green), and Fundamentals of computer (purple). The score segments are: 90~100 (人), 80~89 (人), 70~79 (人), 60~69 (人), and 0~59 (人). The y-axis ranges from 0 to 7. The data is as follows:</p> <table border="1"> <thead> <tr> <th>Score Segment</th> <th>University English</th> <th>Advanced mathematics</th> <th>University Chinese</th> <th>Fundamentals of computer</th> </tr> </thead> <tbody> <tr> <td>90~100 (人)</td> <td>2</td> <td>0</td> <td>2</td> <td>4</td> </tr> <tr> <td>80~89 (人)</td> <td>3</td> <td>6</td> <td>4</td> <td>3</td> </tr> <tr> <td>70~79 (人)</td> <td>0</td> <td>2</td> <td>2</td> <td>2</td> </tr> <tr> <td>60~69 (人)</td> <td>3</td> <td>1</td> <td>1</td> <td>0</td> </tr> <tr> <td>0~59 (人)</td> <td>2</td> <td>1</td> <td>1</td> <td>1</td> </tr> </tbody> </table> </div> <p>Task 5. Generate a visual chart based on the data from the achievement statistical analysis sheet.</p>	Score Segment	University English	Advanced mathematics	University Chinese	Fundamentals of computer	90~100 (人)	2	0	2	4	80~89 (人)	3	6	4	3	70~79 (人)	0	2	2	2	60~69 (人)	3	1	1	0	0~59 (人)	2	1	1	1
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The scaffold	During the implementation of the task, the teacher can provide some video materials of the spreadsheet for students' reference, and the students can also search the relevant materials using the Internet search engine.																														
Evaluation criteria	Considering 3 evaluation criterions: group can evaluate each other and the teacher comment. whether 1st it meets the requirements of the teacher?, 2nd it is practical and universal?, and 3rd it is innovative?. For example, students can use short operation steps to implement the desired function.																														

The teaching process based on cognitive load theory

Firstly, the learning process is divided into three stages: the pre-class stage, the in-class stage and the after-class stage.

According to Cognitive Load Theory (CLT), human cognition is divided into the intrinsic cognitive load, extraneous cognitive load and germane cognitive load. The traditional view is, during information processing people in the working memory load is affected by the elements interactive learning task itself (intrinsic cognitive load), formal learning tasks (extraneous cognitive load) as well as learners' willingness to build graphic and automation (Plass, Moreno, & Brünken, 2010) in the process of learning the mental effort (germane cognitive load). Intervening through reasonable teaching design is a way to reduce the extraneous cognitive load.

For a long time, CLT has been focused on the development of instructional methods to reduce extraneous load. But recent research are increasingly dealing with manipulations of intrinsic and germane load, as well as interactions between instructional methods and the level of expertise of the learner (Van Merriënboer & Ayres, 2005). We can adopt the following principles (Van Merriënboer & Ayres, 2005) :

Firstly, dealing with High-Element-Interactivity Materials: Intrinsic Cognitive Load.

If the intrinsic cognitive load of interactivity is too high, we can simplify learning tasks in the early stages to reduce the intrinsic cognitive load. (Van Merriënboer & Ayres, 2005).

Secondly, dealing with Learners' Motivation to Learn: Germane Cognitive Load.

Considering that students may less likely to use their processing resources during the learning process, teachers need to encourage them to invest mental effort in graphical construction and automation (Plass, Moreno, & Brünken, 2010). Increasing the variability of practice is an effective way to motivate students to generalize and distinguish cognitive schemas, which is a pictorial construction process related to the associated cognitive load. In addition, the teaching operation during learning will also stimulate the students to make efforts in the process of schematic construction. For example, operations require students to actively interact with the learning material (e.g., help students organize procedural steps or a series of events; help them manipulate pictures or animations) or interpret the material by themselves (for example, let them process annotations). Therefore, the motivational effect of teaching methods is very important.

After studying cognitive load theory, scholars have proposed the relationship between brainpower and performance from the perspective of motivation. Also, the result pointed out that low task participation indicates low brainpower binding performance with low investment, contrary with those high participation who can improve performance and investment.

Thirdly, Dealing with Expertise Development: Toward Adaptive E-learning.

As teachers, we should pay close attention to the professional development and changes of students in the teaching process, develop dynamic teaching methods, and adapt teaching to learners' individual needs. Since the level of professional knowledge of learners is constantly measured according to their performance and cognitive load, teachers should dynamically adjust the teaching according to the needs of individual learners.

According to Li, Mao, and Yang (2017), with the development of "Internet +" education, the higher vocational teaching model and information tools like mobile Internet and cloud computing were deeply integrated, and various types of teaching activities with rich content were carried out. The vocational education cloud has been used as the platform for the course "Application of Electronic Technologies". Three learning phases—Before-class, in-class, and after-class—were created in accordance with the design of the course resources. The modern teaching approach of "ability focused and student-centred" was highlighted through the online and offline mixed teaching of three teaching links: fundamental learning, fine design, and active application. The teaching methodology was effective, and the students' self-orientation, active learning capacity, and vocational post-ability had all greatly improved. Huang (2022) Used "Building Materials" as an example, this study developed the teaching of a "three-ring linkage" course, examined the precise implementation steps of the hybrid learning mode based on the vocational education cloud before, during, and after class, and evaluated the educational impact. As a result of the deep integration of information technology into education and teaching practices, it was thought that the traditional classroom's teaching style was constantly changing. Blended learning, which naturally combined traditional teaching with online learning, was crucial for enhancing students' initiative and innovation in their learning. He (2022) Analyzed the characteristics and cognitive ability of deaf students in thinking, perception and information acquisition mode, investigated the feasibility

of carrying out information-based teaching, analyzed and refined the learning objectives of "practical writing", and then rearranged the teaching plan of "practical writing" according to the previous investigation and analysis. By means of the vocational education cloud platform, the rearranged teaching content was arranged orderly in three links before class, during class and after class, so as to provide the necessary support for deaf students to carry out independent learning and teamwork learning. Finally, the design of teaching evaluation, by using the combination of process evaluation and summative evaluation, to test the achievement of teaching objectives in an all-round way. Li, Ren, Guo (2021) used the vocational education cloud platform to carry out teaching activities, and make information teaching resources such as micro-lessons, animations, courseware and teaching plans according to knowledge points; The content of the project task was broken down according to the three online and offline teaching stages before class, during class and after class, and multiple teaching links such as discussion, voting, quick answer, group PK (Player Killer) and quiz were designed.

Before class - students learn independently

The ease of processing information in working memory is a prime concern of CLT. It may be necessary to reduce the intrinsic cognitive load by simplifying the learning tasks in the early stages of learning. Teachers release tasks through the cloud, and then students log on to the cloud, check the task book, and organize group discussion. Teachers and students interactively ask and answer questions on the platform. Through the data on the platform, teachers understand the knowledge mastered by students and prepare for the teaching of new knowledge points.

In class - student task implementation

Regarding to the teaching process of E-commerce Data Analysis and Processing course, in order to enable students to learn effectively, we first present information in the case of a small number of relevant elements interacting, and then gradually add more interactive element information as needed. For example, we first put forward the basic steps of E-commerce data analysis operation, ask the students to discuss and report in groups. Then on the basis of students' understanding of the basic knowledge of E-commerce data analysis operation, we gradually increase the difficulty, and let students use the computer to solve practical work problems.

Then, in the teaching process, we can ask the students to carry out the related teaching operations and stimulate them to construct the process of schematics. For example, we can adopt operations that require students to actively interact with the learning material (e.g., help students organize procedural steps or a series of events; help them manipulate pictures or animations) or interpret the material by themselves (for example, ask them to process annotations).

After class - students design and make

As teachers, we should pay close attention to the professional development and changes of students in the teaching process, develop dynamic teaching methods, and adapt teaching to the individual needs of learners.

Considering that the level of professional knowledge of learners is constantly measured according to their performance and cognitive load, teachers should dynamically adjust the teaching according to the needs of individual learners. For example, during the teaching process, teachers can evaluate students' professional level at any time. According to students' mastery of basic knowledge of E-commerce operation, teachers can use dynamic teaching methods to propose solutions to practical work problems by using the cloud, recording videos and uploading them to the vocational education cloud. The teachers logs on the vocational education cloud to

check the design and effect of the E-commerce operation and adjusts the next teaching strategy according to the task completion of students.

Through the use of the vocational education cloud, we can integrate students' three types of knowledge, namely, Student Content Knowledge (SK), Student Cognitive knowledge (SCK), and Student Technology knowledge (STK). Students can construct the framework of Student Technology, Cognitive and Content Knowledge (TSCCK) by completing related learning tasks. (Figure 2.7)

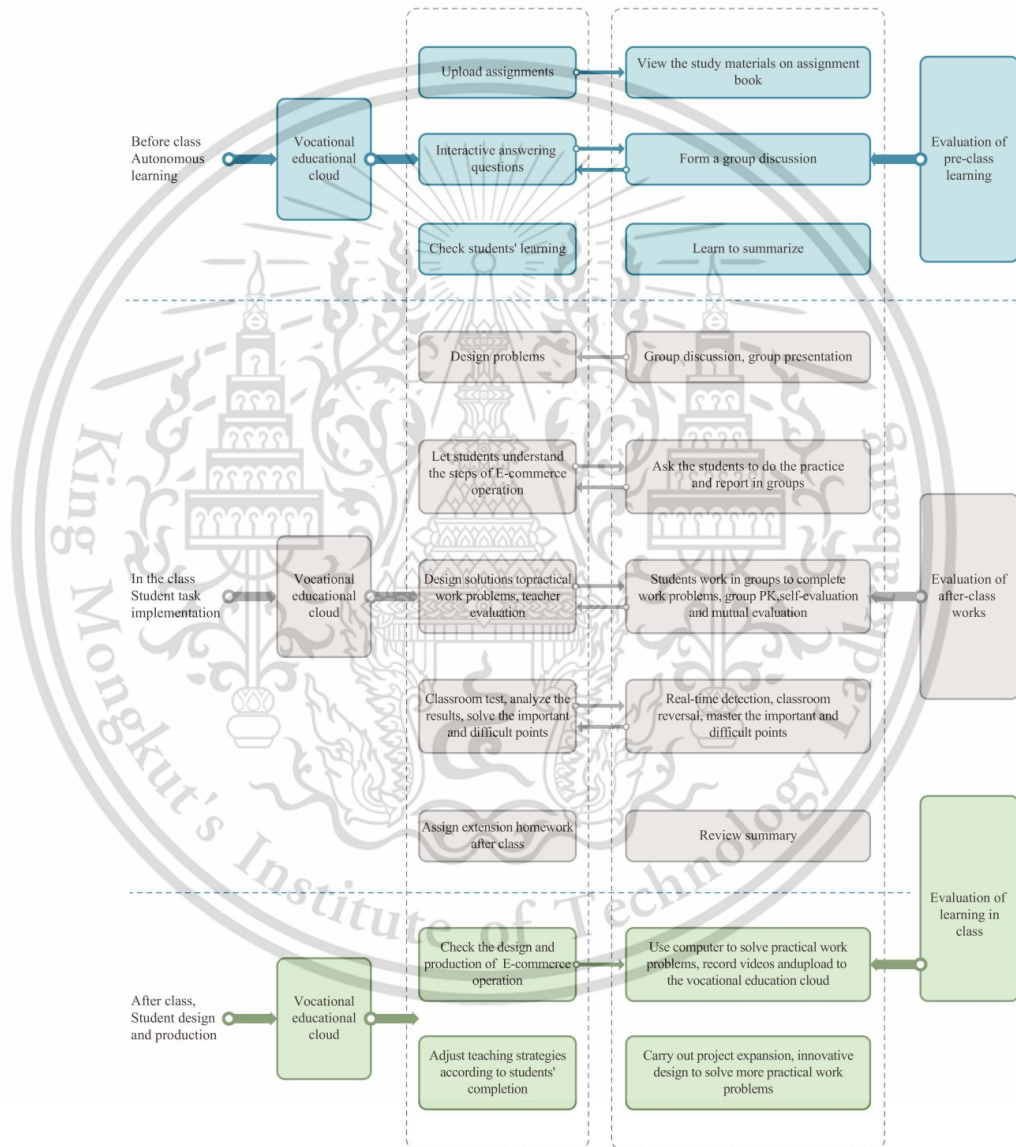


Figure 2.7 Cloud of vocational education teaching model diagram

2.2.7 Related work

Cognitive load

Hawthorne, Vella-Brodrick, and Hattie (2019) claimed that students'

well-being may operate as a cognitive load-reducing agent and provided evidence from more general literature on the methods by which well-being lessens the cognitive burden placed on a student's working memory. Positive emotions, the lack of painful emotions, high academic buoyancy, and cognitive modulation were all postulated as the processes for decreasing extraneous load and enhancing germane load.

According to Wang, Cheng, and Wang (2022), the cognitive load has a considerable impact on the efficacy of learning. The three categories of cognitive load—intrinsic, extraneous, and germane—were crucial for assisting teachers in creating engaging lesson plans for their pupils. To fully understand the methods utilized to measure the connection between brain activity and cognitive load during learning tasks. Based on cognitive-load theory, this study assessed cognitive burden during mathematical computations in the preliminary stage. Used three different types of stimuli (Chinese numerals, coloured Arabic numerals, and uncoloured Arabic numerals), and compared event-related potentials to assess carryover and additions without carryover additions. The design determined the extraneous and germane cognitive load to assess the N1 (100-150 ms) and P2 (200-300 ms) components and the relevant cognitive load to measure the N1 (100-150 ms) and P2 (200-300 ms) components in accordance with the idea and reasoning of cognitive-load theory.

Chen and Woolcott (2019) held the opinion the cognitive load theory served as a design principle for efficient learning. Five principles, which were fundamental building blocks for many well-established and well-tested cognitive load effects, could be used to describe the cognitive architecture that served as the foundation for cognitive load theory. One of these proven benefits, the worked example effect, suggested that demonstrating worked solutions to novices rather than asking them to come up with their own could speed up learning by lowering cognitive burden. This essay showed how the worked example effect may be used to create engaging podcasts to advance math abilities.

The Vocational Education Cloud

Deng (2022) took the "Kindergarten Class Management" course of preschool education major in higher vocational education as an example and used the vocational education cloud for teaching. Teachers used the platform of the vocational education cloud to release teaching tasks or teaching resources, so as to effectively grasp the learning progress of students. Students obtained the teaching tasks of teachers through the app (application) of "smart Vocational Education" and arrange to learn independently. In this way, students improved their learning efficiency and teachers improved their teaching management ability.

Zhao (2022) pointed out that in order to encourage student autonomy in learning, a new teaching method called the divided classroom divides the class time in half, giving the teacher half the time and giving the other half to the students for discussion, and put a lot of effort into the teaching status, implementation, and effect of the "digital electronic technology" course. Particularly in the implementation phase, planned the teaching in accordance with the classroom's teaching steps and had successful outcomes. Divided classrooms showed through practice to be an effective teaching reform strategy and an excellent way to engineer teaching.

Liu and Duan (2023) used the course "sensor application technology" as an example, the design of blended teaching was carried out, the overall flow chart of blended teaching was given, and the specific design process was analyzed. This was done in light of the current state of online learning platforms under the background of "Internet +" and the shortcomings in high vocational education. The hybrid teaching

model built on the cloud platform for vocational education provided advantages over the traditional teaching model, which had been demonstrated in practice, and it was worthwhile to promote and use.



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CHAPTER 3

RESEARCH METHODOLOGY

3.1 Introduction

This chapter presents the research methodology employed in the current study, which aimed to achieve the following central objectives: (1) To find the status of the Chinese Vocational students' technology, cognitive and content knowledge (TSCCK) with a cloud. (2) To develop the TSCCK model with a cloud to enhance the cognitive load and learning achievement of Chinese Vocational students. (3) To find the effect of the TSCCK model on the cognitive load and learning achievement of Chinese Vocational students. This chapter includes the research design, participants, and research instruments for each stage of the research, as well as methods of data collection and data analysis of the study.

3.2 Research Design

This study employed research and development approach, and was conducted in three distinct phases, as outlined below:

3.2.1 Phase 1: to find the status of the Chinese Vocational students' technology, cognitive and content knowledge.

1) Study, analyze and synthesize cognitive load theory for the development of the TSCCK model, cloud and Gagné's Nine Events of Instruction.

Data source: 30 Research papers

Research Instrument: Data Record Form

Data analysis: Content analysis

2) Find the status of the Chinese Vocational students' technology, cognitive and content knowledge.

Data source: Ninety vocational students majoring in E-commerce were selected randomly, using simple random sampling, from a pool of 115 vocational students at GuiZhou Vocational Technology College of Electronics & Information in China.

Research Instrument: Questionnaire

Data analysis: Mean and Standard Deviation

3.2.2 Phase 2: to develop the TSCCK model with a cloud for Chinese Vocational students.

1) To develop, assess and evaluate the TSCCK model with a cloud for Chinese Vocational students.

Data source: Five experts in educational technology by a focus group interview

Research Instruments: Questionnaire and the IOC form

Data analysis: Mean and Standard Deviation

2) Find the efficiency of the TSCCK model with a cloud for Chinese Vocational students.

Data source: 10 vocational students majoring in E-commerce

Research Instruments: Cloud with TSCCK, lesson plans, cognitive load tools (WP scale), and E-commerce test

Data analysis: Criteria 80% for achievement test and cognitive load (WP scale)

- under 28.1 point to 42.0 point
- 3.2.3 Phase 3: to find the effect of the TSCCK model with a cloud for Chinese Vocational students.
- Prepare for the implementation of the TSCCK model
 - Determine research design
 - Specify the population and samples
 - Implement the TSCCK instructional model in the Cloud
 - Data analysis: MANOVA

Table 3.1 Research process of TSCCK model development based on cognitive load theory

<p>Phase 1: to find the status of the Chinese Vocational students' technology, cognitive and content knowledge.</p> <p>1) Study, analyze and synthesize cognitive load theory for the development of the TSCCK model, cloud and Gagné's Nine Events of Instruction.</p> <ul style="list-style-type: none"> Data source: 30 Research papers Research Instruments: Data Record Form Data analysis: Content analysis <p>2) Find the status of the Chinese Vocational students' technology, cognitive and content knowledge.</p> <ul style="list-style-type: none"> Data source: Ninety vocational students majoring in E-commerce were selected randomly, using simple random sampling, from a pool of 115 vocational students at Guizhou Vocational Technology College of Electronics & Information in China. Research Instrument: Questionnaire Data analysis: Mean and standard deviation <p>Phase 2: to develop the TSCCK model with a cloud for Chinese Vocational students.</p> <p>Step 1:</p> <p>1) To develop, assess and evaluate the TSCCK model with a cloud for Chinese Vocational students.</p> <ul style="list-style-type: none"> Data source: five experts in educational technology by a focus group interview Research Instruments: Questionnaire and IOC form Data analysis: Mean and standard deviation <p>Step 2:</p> <p>2) Find the efficiency of the TSCCK model with a cloud for Chinese Vocational students</p> <ul style="list-style-type: none"> Data source: 10 vocational students majoring in E-commerce Research Instruments: TSCCK model with a cloud, lesson plans, cognitive load tools (WP scale), and E-commerce test Data analysis: Criteria 80% for an achievement test and cognitive load (WP scale) under 28.1 to 42.0 point
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Table 3.1 (Continued)**Phase 3: to find the effect of the TSCCK model with a cloud for Chinese Vocational students.**

- 1) Prepare for the implementation of the TSCCK model
Determine research design

Experiment group	X1	O1	O2
Control group	X2	O3	O4

X1 is the TSCCK model with a cloud-based on cognitive load theory

O1 refers to the cognitive load test score of the experiment group

O2 refers to the E-commerce test score of the experiment group

X2 is the traditional teaching method

O3 refers to the cognitive load test score of the control group

O4 refers to the E-commerce test score of the control group

Specify the population and samples

Implement the TSCCK instructional model in the cloud

Instrument: E-commerce test and WP scale (cognitive load tool)

Data analysis: MANOVA

Phase 1: to find the status of the Chinese Vocational students' technology, cognitive and content knowledge.

- 1) Study, analyze, and synthesize cognitive load theory for the development of the TSCCK model with a cloud and Gagné's Nine Events of Instruction.

I conducted a comprehensive analysis of cognitive load theory, utilizing a variety of resources such as literature, books, professional journals, and online sources. The cloud technology is utilized in teaching design, and informed by cognitive load theory, a well-designed teaching approach is implemented to alleviate both intrinsic and extraneous cognitive load for students, while facilitating an increase in their germane cognitive load; Gagné's Nine Events of Instruction is an effective teaching framework that enables students to develop their knowledge and skills in E-commerce data analysis and processing, progressing from fundamental theoretical concepts to advanced practical applications. Throughout the teaching process, these theories and methods are fully integrated and applied to the TSCCK model, resulting in improved cognitive load and learning outcomes for students.

Data source: 30 Research papers

To verify the hypothesis and successfully complete the paper, the researcher referred to numerous relevant professional books, including *The Handbook of Educational Communication and Technology Research, Cognitive Load Theory* (Spector, Merrill, Elen, & Bishop, 2014) and Gagné's Nine Events of Instruction. Additionally, the researcher paid close attention to journals such as SJR and Australasian Journal of Educational Technology; The author also referred to John Sweller (1988) and Richard Mayer (2009), and conducted a comprehensive examination of a cloud.

Table 3.2 Documents related to TSCCK model

Papers	Student Content Knowledge (SK)	Student Cognitive Knowledge (SCK)	Student Technology Knowledge (STK)
<i>Abdurrahman et al. (2019)</i>	√	√	
<i>Aisyah, Setiawan, & Munir (2021)</i>	√	√	√
<i>Arifin, Nurtanto, Priatna, Kholifah, & Fawaid (2020)</i>	√	√	√
<i>Backfisch, Lachner, Hische, Loose, & Scheiter (2020)</i>	√	√	√
<i>Dong, Xu, Chai, & Zhai (2020)</i>		√	√
<i>Evens, Elen, Larmuseau, & Depaepe (2018)</i>	√	√	√
<i>Kramer, Förtsch, Boone, Seidel, & Neuhaus (2021)</i>	√	√	√
<i>Liepert & Borowski (2019)</i>	√	√	
<i>Malik, Rohendi, & Widiaty (2019)</i>	√	√	√
<i>Nilsson & Karlsson (2019)</i>			√
<i>Tseng, Chai, Tan, & Park, (2022)</i>			√
<i>Soler-Costa, Moreno-Guerrero, López-Belmonte, & Marín-Marín, (2021)</i>		√	√
<i>Lachner et al., (2021)</i>			√
<i>Kaleli, (2021)</i>	√	√	√
<i>Schmid, Brianza, & Petko, (2020)</i>			√
<i>Valtonen et al., (2020)</i>		√	√
<i>Santos & Castro, (2021)</i>			√
<i>Rienties, Lewis, O’Dowd, Rets, & Rogaten, (2022)</i>	√	√	√
<i>Aktaş & Özmen., (2020)</i>	√	√	√
<i>Tondeur, Scherer, Siddiq, & Baran, (2020)</i>			√
<i>Roussinos & Jimoyiannis, (2019)</i>	√		√
<i>Juanda, Shidiq, & Nasrudin, (2021)</i>	√	√	√
<i>Celik., (2023)</i>	√	√	√
<i>Lavidas, Katsidima, Theodoratou, Komis, & Nikolopoulou, (2021)</i>		√	√
<i>Hill & Uribe-Florez, (2020)</i>	√	√	√
<i>Raygan & Moradkhani, (2022)</i>			√
<i>Nuangchalerm, (2020)</i>			√
<i>Koh, (2019)</i>		√	√
<i>Cheng, Molina, Lin, Liu, & Chang., (2022)</i>	√	√	√
<i>Almaiah et al., (2022)</i>		√	

The aforementioned preliminary studies served as a relevant foundation for the subsequent paper writing.

Research Instruments: Record data form

Table 3.3 Record data form

Author Name:
Research Title:
Journal Name:
Topic and Detail Cognitive load:

Table 3.4 An Example of the data record

Author Name: John Sweller, Jeroen J. G. van Merriënboer & Fred Paas
Research Title: Cognitive Architecture and Instructional Design: 20 Years Later
Journal Name: Educational Psychology Review
Topic and Detail Cognitive load: <ol style="list-style-type: none"> 1. The second section, following the introduction, presents a brief history of cognitive load theory. It begins by discussing the human cognitive architecture as presented in the 1998 article, followed by a description of the categories of cognitive load followed by the seven cognitive load effects discussed in that article. 2. The third section discusses the major developments in cognitive load theory between 1998 and 2018: firstly, the strengthening of its theoretical basis by grounding it in evolutionary psychology; secondly, its extension to the level of course and curriculum design in the four-component instructional design model; thirdly, introducing a series of new cognitive load effects including so-called compound effects; fourthly, introducing new methods for measuring the different categories of cognitive load. 3. The 1998 article entitled "Cognitive Architecture and Instructional Design" discussed human cognitive architecture including an outline of cognitive load theory and its general principles. It also provided a description of seven cognitive load effects generated by the theory and issues associated with measuring cognitive load.

Data analysis: content analysis

During the research stage, the author consulted a large number of relevant professional books, including (*Spector, Merrill, Elen, & Bishop, 2014*), which mainly introduce the application of various technologies in the field of education and its future development prospects. It is an excellent resource for broadening the pattern of professional knowledge.

The book, "*Cognitive Load Theory*" primarily describes the use of appropriate teaching design to facilitate effective teaching, and reduce students' intrinsic cognitive load and extraneous cognitive load, thereby enhancing germane cognitive load. This provides teachers with valuable guidance for designing effective teaching strategies.

Australian Journal of Educational Technology is also an excellent publication, and reading relevant articles has significantly contributed to my professional knowledge. I also have a particular appreciation for reading related articles published by John Sweller, which broaden and deepen my understanding of cognitive load theory. It is through the influence of these relevant professional books, renowned authors and exceptional educational technology journals that I was able to integrate the knowledge and establish the "TSCCK" model. Employing the technology "cloud", I was able to apply what I have learned to verify the hypothesis presented in this paper.

2) Find the status of the Chinese Vocational students' technology, cognitive and content knowledge.

Data source: Ninety vocational students majoring in E-commerce were selected randomly, using simple random sampling, from a pool of 115 vocational

students at GuiZhou Vocational Technology College of Electronics & Information in China.

Research Instruments: Questionnaire

To determine the current status of vocational college students' technology, cognitive load, and content knowledge, a 5-point Likert scale was utilized, consisting of two parts: technology, cognitive load and content knowledge. The scoring standard is divided into 5 dimensions, namely, Part 1: Strongly Disagree/ Disagree/ Not Sure/Agree/ Strongly Agree and Part 2 : Poor/Fair/Average/Good/Excellent(Table 3.5).

Table 3.5 Questionnaire on the current status of technology, cognitive and content knowledge of vocational college students

The current status of technology, cognitive and content knowledge of vocational college students				
Questions	Strongly agree	Disagree	Agree	Strongly disagree
	5	4	3	2
Part One: Attitude toward Technology knowledge				
1. Do you think the stated improvements in skills and knowledge resulting from the use of computers in the learning process were achieved?				
2. The content of the operation on the computer was relevant to my study				
3. Technology activities enhanced my understanding of the skills				
4. Sufficient instructions were given to allow me to apply the skills back to the study				
5. Study materials supported me technology				
6. The audio/visual materials added the value of application in technology				
7. The delivery method used (e.g., cloud platform, web-based)was appropriate				
8. The Technology met my learning needs				
	Excellent			Poor
Part Two: Current status of students on Content and cognitive knowledge				
9. Content of the E-commerce				
10. Presentation style				
11. Ability to communicate in a clear manner				
12. Feedback and direction during the class				
13.Participation/interaction in class				
14. Contribution to overall learning effectiveness				

Data analysis: Mean and Standard Deviation

The data collected was analyzed using SPSS software to obtain the Mean and Standard Deviation. Based on the results, the status of students' technology, cognitive load, and content knowledge was interpreted as follows:

Table 3.6 The interpretation of the scores

Interpretation (Part 1)	Interpretation (Part 2)
4.50-5.00 Meaning Strongly Agree	4.50-5.00 Meaning Excellent
3.50-4.49 Meaning Agree	3.50-4.49 Meaning Good
2.50-3.49 Meaning Not Sure	2.50-3.49 Meaning Average
1.50-2.49 Meaning Disagree	1.50-2.49 Meaning Fair
1.00-1.49 Meaning Strongly Disagree	1.00-1.49 Meaning Poor

Phase 2: to develop the TSCCK model with a cloud for Chinese Vocational students.

To improve the academic performance of vocational students in China, this study developed the model that combines the application of cognitive load theory with the cloud. The development of the TSCCK instruction model based on cognitive load theory is:

1) To develop, assess and evaluate the TSCCK model with a cloud for Chinese Vocational students.

After studying the pedagogical principles of the TSCCK instructional model based on cognitive load theory, I established the learning objectives to improve the cognitive load and learning achievement of vocational students. The objectives of the TSCCK model with cloud technology aims to enhance their cognitive load and learning achievement.

Instructional design model

There are five steps in the developed teaching model that were analyzed from Chao (2020) , Gao (2008) and Gagné' et al. (1992):

- 1) Stimulate the students' prior knowledge.
- 2) Instruct the students to follow the teacher's actual operation.
- 3) Deal with the operational tasks, the teacher emphasizes the key points.
- 4) Assign operational tasks to the students while reminding them of potential errors.
- 5) Students practice assigned operational tasks while receiving individual guidance and having their questions answered by the teacher.

Table 3.7 outlines the objectives for each learning step, as well as the respective roles of the teacher and students:

Table 3.7 Learning steps

Five learning steps	
Step 1. Stimulate the students' prior knowledge.	
The main objectives of this step are to: 1) Connect student's prior knowledge with the content of the current lesson, and 2) Minimize students' cognitive load on absorbing new knowledge.	
1. Subject Teaching Before beginning a lesson, teachers should communicate two key points to students: 1) The relevance of their prior knowledge to the upcoming material, and 2) The learning objectives and expected outcomes of the lesson.	
1.1 Teacher's role By assessing students' completion of cloud-based homework, teachers can gauge their understanding of foundational knowledge.	1.2 Students' role Students complete their cloud-based homework, seek clarification from the teacher, and then collaborate with peers to share their knowledge.
2. Minimize students' cognitive load	
2.1 Teacher's role The teacher utilizes cloud-based instruction to teach students how to operate a computer in a simple and user-friendly manner.	2.2 Students' role By logging into the cloud, students can easily access and engage with content assigned by the teacher. This streamlined process reduces cognitive load and promotes efficient learning.
Step 2. Instruct the students to follow the teacher's actual operation.	
The second step has two primary objectives: 1) To introduce the learning task that students will be completing; 2) To provide guidance to students on how to follow the teacher's actual operation.	
1. Task Introduction	
1.1 Teacher's role The teacher presents the learning tasks to the students, along with the precautions for the operation process.	1.2 Students' role Students are required to listen attentively to the teacher's explanation regarding the specific operation process.
2. Guiding student's actual operation To alleviate students' cognitive load, create a relaxed learning atmosphere, and facilitate their completion of learning tasks, the teacher initially emphasizes to students that acquiring practical knowledge is a straightforward process.	
2.1 Teacher's role	2.2 Students' role
The teacher fosters students' interest in learning, enhances their focus on the course contents, and guides them in following the procedures to perform and accomplish relevant tasks.	Students attentively listen to the teacher's instructions and complete the relevant tasks according to the teacher's specifications.
Step 3. Deal with the operational tasks, the teacher emphasizes the key points.	
The primary goal of this learning stage is for students to operate relevant tasks, while the teacher highlights essential points.	
1. The opportunity The purpose of this learning process is to provide students with an opportunity to acquire and master the operational essentials of knowledge points.	
1.1 Teacher's role Throughout the learning process, the teacher acts as a scaffolder, providing assistance to students during critical moments.	1.2 Students' role Students collaborate in groups and use group learning methods to accomplish relevant learning tasks.
2. Presentation	
1.1 Teacher's role The teacher requests that each group appoint a representative to share their learning to the class. Group members can engage in discussion with each other and upload their comments to the cloud.	1.2 Students' role A student from each group is chosen to serve as the representative, sharing the group's learning outcomes with the rest of the class and uploading them to the cloud.

Table 3.7 (Continued)

Step 4. Assign operational tasks to the students while reminding them of potential errors.	
This step is designed to facilitate group reporting and discussion of the previous step, with the aim of enhancing students' understanding of the relevant operational procedures and achieving better learning outcomes in subsequent studies.	
2.1 Teacher's role During the learning process, the teacher serves as a "troubleshooter", encouraging students to perform correct operations.	2.2 Students' role Students engage in group discussions regarding the methods and operation steps of completing the learning tasks in groups, as well as tasks that require special attention, to prepare for upcoming learning tasks.
Step 5. Students practice assigned operational tasks while receiving individual guidance and having their questions answered by the teacher.	
In the last step, the teacher assigns operational tasks, students practice, and the teacher provides individualized tutoring.	
2.1 Teacher's role The teacher provides students with opportunities to work independently, offers individual assistance, and responds to questions.	2.2 Students' role Students can operate independently, and can seek assistance from the teacher if they have any questions.

Data source: Five experts in educational technology by a focus group interview

As focus groups have the potential to produce concrete projects for conducting questionnaires, they are used as a research method in certain studies (Nassar-McMillan & Borders, 1999; Nassar-McMillan & Borders, 2002).

It aims to motivate researchers and education experts to contemplate the potential outcomes of utilizing focus groups, and to prove that it is a valuable and productive process.

Thus, if researchers wish to develop learning tools that are appealing to both students and teachers, a good starting point could be to identify the information that students acquire and retain in the classroom, as well as the sentiments or perspectives of teachers and focus groups on sensitive issues in the course.

Research Instrument: Questionnaire and IOC form

According to the components of the TSCCK model, namely: 1) Analysis, 2) Design, 3) Cloud-based learning, 4) Instruction development, 5) Model implementation, and 6) Model revision, I designed the evaluation questionnaire for the TSCCK Model. The questionnaire, which utilized a 5-point Likert scale, was reviewed by 5 experts, and achieved an IOC score of 1, indicating that all questions were deemed acceptable.

The validation of the TSCCK model was conducted through a focus group interview with five experts. The evaluation form, which utilized a 5-point Likert scale, covered the following aspects:

Table 3.8 The evaluation form of the TSCCK model

Questions	Strongly agree-----Strongly disagree				
	5	4	3	2	1
1. Student Technology knowledge (STK) refers to their knowledge of both conventional and emerging technologies that can be integrated into the learning process.					
2. The cloud is very convenient for teacher to use.					
3. Before teaching, the technology provided by the cloud can simplify learning tasks and reduce cognitive load.					
4. For example, students log in to the cloud with their accounts, complete relevant learning tasks according to the instructions of the teacher, and engage in relevant practical exercises.					
5. By utilizing the vocational education cloud with TSCCK model, students can construct the cognitive and content knowledge by completing relevant learning tasks.					
6. The unique goal of the TSCCK model is to enhance students' cognitive load and learning achievement through the application of cloud technology.					
7. Student Cognitive knowledge (SCK) refers to the concept of cognitive load involved in cognitive load theory and how teachers should adopt appropriate instruction design to promote students' learning.					
8. From the perspective of cognitive load theory with the cloud, students are presented with learning tasks to make them feel simple and easy to operate, which can reduce their cognitive load.					
9. The technical support provided by the cloud and appropriate teaching methods, and the new way of learning material presentation , reduce the intrinsic cognitive load and extrinsic cognitive load of students.					
10. To promote the smooth implementation of the fundamentals of fundamentals of E-commerce of teaching activities supported by the cloud, teachers must design the steps of teaching activities reasonably, to not only reduce the cognitive load of students but also stimulate their learning interest.					
11. Student Content knowledge (SK) refers to any subject-related knowledge that a student should learn.					
12. The cloud will record, for example, the completion of each student's automatic homework, check-in status, attendance status, etc. These can be used as usual grades and formative assessments; students' mid-term test scores and final scores can also be automatically displayed on the cloud for summative judgments.					
13. The instructional steps for the TSCCK model are: Step 1: Stimulate the students' personal prior knowledge Step 2: Guide the students to follow the teacher Step 3: Deal with the operational tasks Step 4: Instruct the operation tasks Step 5: Assign operation tasks These teaching steps enhance students' understanding of the learning material.					
14. In the TSCCK model, the teacher introduces the learning tasks to the students, as well as the precautions for the operation process. Students carefully listen to the teacher's instructions and complete the relevant tasks according to the teacher's requirements. These teaching steps enhance students' understanding of the learning material.					
15. In the TSCCK model, during the learning process, the teacher plays the role of providing scaffolding, to help students at critical moments. Students work in groups and use group learning methods to complete relevant learning tasks. These teaching steps enhance students' understanding of the learning material.					
16. In the TSCCK model, during the learning process, the teacher plays the role of "troubleshooter", who urges students to carry out the correct operation. The students discuss the methods and operation steps of completing the learning tasks in groups. These teaching steps enhance students' understanding of the learning material.					
Total					

Data analysis: Mean and Standard Deviation;

As the experts involved in the study were from various universities across China, the online platform "Questionnaire Star" (www.wjx.cn) was chosen for its convenience in data collection. This platform offers equivalent functions to Amazon Mechanical Turk and allowed the experts to complete the questionnaire and evaluate the effectiveness of the the TSCCK model.

A quality evaluation form was utilized in the study, utilizing a 5-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree).

Table 3.9 The interpretation score of the TSCCK model

Interpretation	
4.50-5.00	Meaning Very Strongly Agree
3.50-4.49	Meaning Agree
2.50-3.49	Meaning Not Sure
1.50-2.49	Meaning Disagree
1.00-1.49	Meaning Strongly Disagree

2) Find the efficiency of the TSCCK model with a cloud for Chinese Vocational students

The cloud, serving as the construction and application platform of the professional teaching resource base, is a function-oriented vocational education major teaching resource base project supported by the Ministry of Education of China in accordance with the requirements of the Manual of Professional Education Teaching Resource Base Construction (Gao, 2020). Building upon this foundation, an integrated design of structured curriculum resources was implemented.

The logic of construction of a professional teaching resource database is based on the online teaching platform of teachers and students within the school. This platform offers operational support for colleges and universities to apply for national and provincial professional teaching resource database projects, while also providing university-specific professional resource databases and online courses that are accessible to the wider community.

The cloud platform, which is school-based, provides each teacher with a corresponding account and permission to utilize the platform for teaching purposes. The platform can be divided into three main parts: pre-class, in-class and after-class.

At the pre-class stage, teachers can access free teaching information resources on the platform and integrate them with their classroom content as needed.

At the in-class stage, teachers make use of the relevant resources and functions of the platform to facilitate their information teaching activities. This includes utilizing the platform for activities such as check-ins, brainstorming, and playing animated videos.

After class, the teacher can administer relevant tests and assign homework, with the system automatically recording students' learning progress.

TSCCK model comprises of three key components: Student Technology Knowledge(STK), Student Content Knowledge(SK), and Student Cognitive Knowledge(SCK). With the aid of cloud-based technology, and through the use of effective teaching methods, knowledge in all three of these areas can be significantly enhanced, particularly when utilizing the principles of Cognitive Load Theory.

Data source:10 vocational students majoring in E-commerce

After using the TSCCK model with a cloud, a post test was conducted involving a sample of 10 E-commerce majors in order to evaluate the influence of the

TSCCK model with cloud-based technology on students' learning achievement.

Research Instruments: TSCCK model with a cloud, lesson plans, cognitive load tools (WP scale), and E-commerce test.

To ensure the accuracy of the study, the researchers meticulously prepared materials related to the formal lecture according to the regulations set forth by the university. Moreover, the procedure and assessment methods employed were identical to those of the formal lecture.

Data analysis: Criteria 80% for achievement test and cognitive load tools (WP scale) under 28.1 point to 42.0 point

Upon completion of the class, the students were assessed based on two factors: their academic performance and cognitive load. The assessment was based on a scoring system that considers the criteria of 80% . Notably, the results obtained using the WP scale were relatively low. (Tsang & Velazquez, 1996) (Table 3.11 and Table 3.12).

In addition, the student test content was divided into two parts. The first part was a predictive test that involved 10 students majoring in E-commerce. The second part was a formal test, which included 62 students randomly selected from a pool of 115 students majoring in E-commerce.

Phase 3: to find the effect of the TSCCK model with a cloud for Chinese Vocational students.

At this stage, to validate the effect of the TSCCK model with cloud-based technology, the researcher intends to utilize the principles of cognitive load theory to implement cloud-based teaching in an actual classroom setting. The following outlines the proposed process for this stage of the study:

1) Prepare for the implementation of the TSCCK model

In preparation for the implementation of the TSCCK model, the researcher has undertaken the following steps: firstly, conducting the research design for the study; secondly, selecting appropriate samples for the purposes of data collection. Details regarding the various stages of the TSCCK model are outlined below.

Determine the research design

The researcher defined the research design as follows: using the cloud for the implementation of the TSCCK model, and conducting two of tests on e-commerce and cognitive load, using MANOVA to obtain the results.

X1 refers to the TSCCK model with a cloud-based on Cognitive load theory

O1 refers to the cognitive load test score from the experiment group

O2 refers to the E-commerce test score from the experiment group

X2 refers to the traditional teaching method

O3 refers to the cognitive load test score of the control group

O4 refers to the E-commerce test score of the control group

Before implementing the model on 62 Chinese vocational students, the test was further refined based on expert feedback and test blueprint guidelines.

Experiment group	X1	O1	O2
Control group	X2	O3	O4

Instrument: E-commerce test and WP scale (cognitive load tool)

The E-commerce test was validated by three experts in the related teaching field for the indexes of items-objective congruence (IOC). The evaluations form covered:

the test is consistent with its objectives. /the validity of the test content.

The appropriateness of the number of test items. /the clarity of the E-commerce operation used in the test. / the appropriateness of the time given.

The evaluation of the test items was conducted by three experts using a scale consisting of three levels: +1 for appropriate, 0 for not sure, and -1 for not appropriate. For items deemed not appropriate, additional comments were requested and highly appreciated. All items were +1, meaning that all items had content validity. (See Appendix J)

WP self-rating scale:

WP self-rating Scale (Tsang & Velazquez, 1996) is a multidimensional subjective workload assessment instrument that has been proven to be effective in assessing people's cognitive load. It was consisting of 7 dimensions with 10 scales.

For the validity, the content of the WP scale items were assessed by three experts in related areas. The three experts were asked to assess the scale of the items using the index of Item-Objective Congruence (IOC), which has a score of -1 to +1, to determine whether each item met the operational definition. All items were +1, meaning that all items had content validity. (See Appendix J)

Table 3.10 Dimension of WP scale

Name of dimension	Meaning of dimension
Central processing resource	The mental resources you have consumed in the process of task selection and execution
Response resources	You feel the mental resources consumed by responding to the task
Spatial coding resources	The mental resources consumed by the spatial activity of your brain during the task
Language coding resources	The mental resources consumed by the speech activity of your brain in the process of completing the task
Visual reception resources	The mental resources you have used to get information from visual channels while completing a task
Auditory reception resources	The mental resources consumed by you to obtain information from the auditory channel in the process of completing the task
Operational resources	In the process of completing the task, you feel the impact of operating your own limbs on the cognitive load

The WP scale comprises seven dimensions, and the following are the operational definition of each dimension:

During the task you just completed, how much mental resources have you invested? Please select the number that suits you after the corresponding psychological resources according to your actual situation, and mark the corresponding position. In this scale, "0" indicates that the resource is not occupied at all, while "10" indicates that the resource is completely occupied.

0. Not at all/1.very, very low occupancy / 2. very low occupancy /3. low mental effort / 4. rather low occupancy /5. neither low nor high occupancy /6. rather high occupancy / 7. high occupancy/ 8. very high occupancy / 9. very, very high occupancy/10.very, very ,very high occupancy

Table3.11 WP self-rating scale

Name of dimension	Score range										
Central processing resource	0	1	2	3	4	5	6	7	8	9	10
Response resources	0	1	2	3	4	5	6	7	8	9	10
Spatial coding resources	0	1	2	3	4	5	6	7	8	9	10
Language coding resources	0	1	2	3	4	5	6	7	8	9	10
Visual reception resources	0	1	2	3	4	5	6	7	8	9	10
Auditory reception resources	0	1	2	3	4	5	6	7	8	9	10
Operational resources	0	1	2	3	4	5	6	7	8	9	10

Table3.12 Interpretation of the WP scale scores

Scores	Interpretation
56.1 point ~ 70 point	Very high cognitive load
42.1 point ~ 56.0 point	High cognitive load
28.1point ~ 42.0 point	Average
14.1 point ~ 28.0 point	Low cognitive load
1 point ~ 14 point	Very Low cognitive load

From table 3.11 and table 3.12, the Maximum score is 70. The average score was from 28.1 point to 42.0 point, meaning the low scores, the low cognitive load.

Specify the population and samples

Population

The population of the study was 115 students from the GuiZhou Vocational Technology College of Electronics & Information in China in 2021-2022 academic year.

Samples

E-commerce major a total of 115 students, from the 115 students, randomly selected 62 students to do the experiment using cluster random sampling.

The first group included thirty-one students .

The second group consisted of thirty-one students .

They were university students majoring in E-commerce, from the GuiZhou Vocational Technology College of Electronics & Information in China.

Implement the TSCCK instructional model in the Cloud

The study included 62 students who were enrolled in the "E-commerce Data Analysis and Processing" course, which is a mandatory component of the E-commerce major curriculum in China. The experiment lasted for four weeks.

MANOVA method was utilized to evaluate the effectiveness of a newly developed teaching process. Students were divided into two groups: one group used the TSCCK model with a cloud, while the other group used the traditional teaching method. Following the class, students were assessed on their knowledge of

E-commerce and cognitive load using the WP self-rating scale. The resulting MANOVA scores were then compared between the two groups.

After using the cloud to implement the TSCCK model, in the teaching of E-commerce knowledge, the cognitive load and learning achievement of Chinese vocational students have been enhanced in the following aspects:

In the first step of learning, the cloud was used to activate students' prior knowledge. In this part, because of the utilization of the cloud, students feel it was simple and easy to understand the knowledge, and their cognitive load was reduced.

In the second step of learning, the students were guided to follow the teacher, who requires students to use electronic classrooms. Task activities were designed as personal learning activities. Students could share their learning completion status with the teacher on the cloud.

The third step of the learning process emphasizes group cooperative learning and handling operational tasks, which has been proven effective in practice due to the needs of teaching.

In the fourth step of the learning process, the teacher provided instruction on operational tasks, which was relevant to the group report and discussion that has just taken place. During this step, the teacher served as a troubleshooter, guiding students towards the correct performance of the operation, while students collaborate in groups to determine the best approach for completing the learning task. By integrating these two components with the operational steps, students were offered increased opportunities and time to fully grasp the operation knowledge.

In the fifth step of learning process, the teacher assigned operation tasks to the students, who perform independent operations on their own. The teacher then answered questions individually, providing students with additional opportunities to review their mastery of knowledge.

The two sub-steps of learning were merged to provide students with ample time to review the learning task.

Data analysis: MANOVA

Assumptions of MANOVA are as follow:

First, test of normality was checked by Shapiro-Wilk test.

Second, the dependent variables had relationship that were checked by Bartlett's test of Sphericity.

Third, all Variance-Covariance matrices in population were equal that were checked by Box's M test.

The collected data was analyzed by the researcher in accordance with the research objectives. Guidelines for data analysis are stated as below.

Table 3.13 Data analysis guide study

Research objective	Data analyses	Instrument
To investigate the effect of the TSCCK model with a cloud on the cognitive load and learning achievement of vocational students.	The MANOVA was used to compare the students' learning achievement and cognitive load.	During the testing phase, the E-commerce data analysis and processing test, along with the WP self-rating scale, were employed.

CHAPTER4

RESULTS

The research entitled “Modeling Students’ Technology, Cognitive and Content Knowledge (TSCCK) through a cloud to enhance Vocational students’ cognitive load and learning achievement consist of three main objectives, namely:

- 1) To find the status of the Chinese Vocational students’ technology, cognitive and content knowledge (TSCCK) with a cloud
- 2) To develop the TSCCK model with a cloud to enhance the cognitive load and learning achievement of Chinese Vocational students.
- 3) To find the effect of TSCCK model on the cognitive load and learning achievement of Chinese Vocational students.

To answer the research objectives, the researcher divided the research objectives into three sections as follows:

Section 1. The results of the status of the Chinese Vocational students’ technology, cognitive and content knowledge (TSCCK).

Section 2. The results of the development of the TSCCK model with a cloud based on cognitive load theory to enhance Chinese Vocational students’ cognitive load and learning achievement.

Section 3. The results of the effect of the TSCCK model with a cloud based on cognitive load theory to enhance Chinese Vocational students’ cognitive load and learning achievement.

4.1 The results of the status of the Chinese Vocational students’ technology, cognitive and content knowledge (TSCCK).

Phase 1: Find the status of the Chinese Vocational students’ technology, cognitive and content knowledge.

I employed simple random sampling to select 90 students out of a total of 115 E-commerce majors to participate in an experiment involving the TSCCK model with a cloud.

To find the proficiency level of Chinese vocational students in technology, cognitive, and content knowledge (TSCCK), we utilized a 5-point Likert scale. This allowed us to evaluate the current status of these areas among vocational college students using a scoring standard divided into 5 dimensions, namely, Part 1: Strongly Disagree/ Disagree/ Not Sure/ Agree/ Strongly Agree and Part 2: Poor/ Fair/ Average/ Good/ Excellent.

According to the test results, students' status of technology, cognitive load, and content knowledge was understood and mastered.

Table 4.1 Mean and Standard Deviation of students' status of technology, cognitive and content knowledge

Questions	Mean	SD	Interpretation
Part One: Attitude toward Technology knowledge			
1. Do you think the stated improvements in skills and knowledge resulting from the use of computers in the learning process were achieved?	4.3	0.6	Agree
2. The content of the operation on the computer was relevant to my study	4.3	0.7	Agree
3. Technology activities enhanced my understanding of the skills	4.4	0.6	Agree
4. Sufficient instructions were given to allow me to apply the skills back to the study	4.3	0.6	Agree
5. Study materials supported me technology	4.3	0.6	Agree
6. The audio/visual materials added the value of application in technology	4.3	0.6	Agree
7. The delivery method used to (e.g., cloud platform, web-based) was appropriate	4.2	0.7	Agree
8. The Technology met my learning needs	4.2	0.6	Agree
Total	4.3	0.5	Agree
Part Two: Current of students' status on Content and cognitive knowledge			
9. Content of the E-commerce	4.2	0.7	Good
10. Presentation style	4.1	0.7	Good
11. Ability to communicate in a clear manner	4.2	0.7	Good
12. Feedback and direction during the class	4.3	0.7	Good
13. Participation/interaction in class	4.1	0.9	Good
14. Contribution to overall learning effectiveness	4.1	0.7	Good
Total	4.2	0.6	Good

Ninety E-commerce students answered a questionnaire which consisting of 14 questions rated on a 5-point Likert scale. The maximum score for each question was 5 points. The results indicate that for questions 1 to 14, the mean score for part one was 4.3 with a standard deviation (SD) of 0.5, while for part two, the mean score was 4.2 with an SD of 0.6. This suggests that students scored above four points, indicating they are agree on level of technology, and good at cognitive, and content knowledge.

4.2 The results of the development of the TSCCK model with a cloud based on cognitive load theory to enhance Chinese Vocational students' cognitive load and learning achievement.

4.2.1 Evaluate the TSCCK model by five experts: a questionnaire survey

Table 4.2 The result of the TSCCK model evaluation form

Questions	Mean	SD	Meaning
1. Student Technology knowledge (STK) refers to their knowledge of traditional and new technologies that can be integrated into learning.	4.8	0.447	strongly agree
2. The cloud is very convenient for the teacher to use.	4.6	0.548	strongly agree
3. Before teaching, the technology provided by the cloud can simplify learning tasks and reduce cognitive load.	4.6	0.548	strongly agree
4. For example, students log in to the cloud with their own accounts, complete relevant learning tasks according to the instructions of the teacher, and carry out relevant practices.	4.8	0.447	strongly agree
5. By utilizing the vocational education cloud with TSCCK model, students can construct cognitive and content knowledge by completing relevant learning tasks.	4.8	0.447	strongly agree
6. The unique goal of the TSCCK model is to enhance students' cognitive load and learning achievement through the application of cloud technology.	4.6	0.548	strongly agree
7. Student Cognitive knowledge (SCK) refers to the concept of cognitive load involved in cognitive load theory and how teachers should adopt appropriate instruction design to promote students' learning.	4.6	0.548	strongly agree
8. From the perspective of cognitive load theory with the cloud, students are presented with learning tasks to make them feel simple and easy to operate, which can reduce their cognitive load.	4.6	0.548	strongly agree
9. The technical support provided by the cloud and appropriate teaching methods, and the new way of learning material presentation, reduce the intrinsic cognitive load and extrinsic cognitive load of students.	4.6	0.548	strongly agree
10. In order to promote the smooth implementation of the fundamentals of E-commerce of teaching activities supported by the cloud, teachers must design the steps of teaching activities reasonably to not only reduce the cognitive load of students but also stimulate their learning interest.	4.6	0.548	strongly agree
11. Student Content knowledge (SK) refers to any subject-related knowledge that a student should learn.	4.6	0.548	strongly agree
12. The cloud will record, for example, the completion of each student's automatic homework, check-in status, attendance status, etc. These can be used as usual grades and formative assessments; students' mid-term test scores and final scores can also be automatically displayed on the cloud for summative judgments.	4.6	0.548	strongly agree
13. The instructional steps for the TSCCK model are: Step 1: Stimulate the students' personal prior knowledge Step 2: Guide the students to follow the teacher Step 3: Deal with the operational tasks Step 4: Instruct the operation tasks Step 5: Assign operation tasks These teaching steps enhance students' understanding of the learning material.	4.8	0.447	strongly agree

Table 4.2 (Continued)

14. In the TSCCK model, the teacher introduces the learning tasks to the students, as well as the precautions for the operation process. Students carefully listen to the teacher's instructions and complete the relevant tasks according to the teacher's requirements. These teaching steps enhance students' understanding of the learning material.	4.6	0.548	strongly agree
15. In the TSCCK model, during the learning process, the teacher plays the role of providing scaffolding to help students at critical moments. Students work in groups and use group learning methods to complete relevant learning tasks. These teaching steps enhance students' understanding of the learning material.	4.6	0.548	strongly agree
16. In the TSCCK model, during the learning process, the teacher plays the role of "troubleshooter", who urges students to carry out the correct operation. The students discuss the methods and operation steps of completing the learning tasks in groups. These teaching steps enhance students' understanding of the learning material.	4.6	0.548	strongly agree
Total	4.65	0.52	strongly agree

The TSCCK model was evaluated by five experts through the questionnaire (5-point Likert scale), in which the maximum mean score was 4.8, and the minimum mean score was 4.6. As can be seen from the table, the overall mean was 4.65 and SD=0.52. Therefore, experts agree with the core idea of the TSCCK model.

4.2.2 The effectiveness of the TSCCK model

To evaluate the effectiveness of the TSCCK model with a cloud for Chinese vocational students, a study was conducted using a sample of 10 students from the E-commerce program. To ensure the accuracy of the research, materials related to the formal lecture were prepared in accordance with college regulations, and the teaching and assessment methods remained consistent with those of the formal lecture. Upon completion of the class, the students were tested for their academic performance and cognitive load, which comprised the two main components of the results.

The test results were evaluated based on the criteria: an achievement test pass rate of at least 80% and a low cognitive load pass rate at least 28.1 point, as outlined in Tables 3.11 and 3.12, respectively (Tsang & Velazquez, 1996).

Table 4.3 The results of learning achievement and cognitive load

Student	Learning achievement	Cognitive load (WP scale)
1	84	22
2	100	23
3	92	32
4	100	21
5	100	26
6	100	30
7	88	22
8	82	32
9	88	25
10	70	26
Mean	90.4	25.9
SD	10.0	4.1

Ten E-commerce students participated in the test, achieving an overall score of 100. The mean score for the learning achievement was 90 which was higher than 80%, while the cognitive load was 26 which was lower than 28.1. As per the criteria outlined in Tables 3.11 and 3.12 (Tsang & Velazquez, 1996), over 80% of the students achieved passing grades with low cognitive load levels.

TSCCK model is a circular instructional design model (Figure 1.1), which is used to improve students' learning ability with the help of the cloud. At its core, the model is based on cognitive load theory. It is a widely used theory to guide teaching. The characteristics of The TSCCK model are learner-centred and guided by cognitive load theory. Based on using the cloud for teaching, the TSCCK model can reduce students' cognitive load, promote the improvement of students' learning ability, and enable them to apply what they have learned to real life.

The TSCCK model was evaluated by experts in related fields. They hold the belief that the TSCCK model is an effective and suitable approach for teaching E-commerce knowledge, due to its foundation on the cognitive load theory and incorporation of cloud technology. Student Technology Knowledge (STK), Student Content Knowledge (SK), and Student Cognitive Knowledge (SCK) are combined in teaching.

The whole process of the TSCCK instructional design model is as follows:

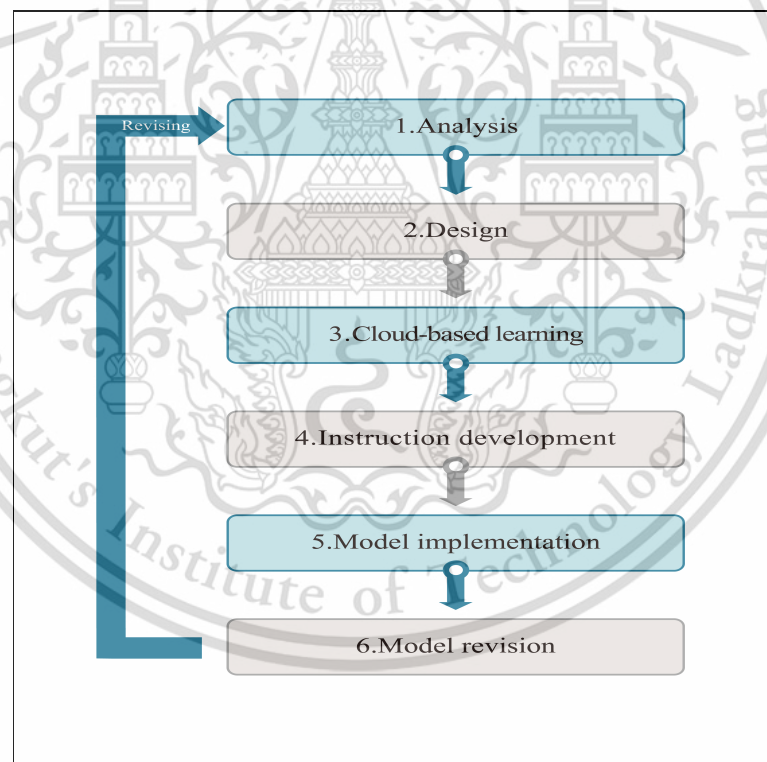


Figure 4.1 TSCCK instructional model

Table 4.4 Components of the TSCCK model

1. Analysis
<p>1.1 Analysing objectives Learning objectives are the expected outcomes or standards for teachers and students to achieve through learning activities. Teaching in the classroom without clear or defined objectives will inevitably lead to inefficient teaching. To optimize the effectiveness of the TSCCK model, it is essential to first establish clear teaching goals. For instance, in the context of E-commerce data analysis and processing, mastering theoretical knowledge without practical operational skills holds no practical significance. Therefore, classroom teaching should prioritize achieving this objective..</p> <p>1.2 Analysing content Teaching content, as a crucial component of the TSCCK model, pertains to the material that teachers present to students in the classroom in accordance with the course materials and teaching objectives. Teachers can tailor the level of difficulty and teaching methods based on the content, and make appropriate adjustments in consideration of the students' capabilities, ensuring that the teaching content aligns with both the students' aptitudes and the learning objectives.</p> <p>1.3 Analysing learners The TSCCK model is student-centred. As such, teachers must obtain a comprehensive understanding of their students' abilities prior to designing the course. This understanding allows teachers to establish the appropriate starting level of the course and adopt suitable teaching strategies to support the learning process. Teachers may consider using the following guidelines to analyze students in this course: -Analysis of students' learning attitude -Starting point ability analysis -Mental state analysis -Analysis of the background knowledge and skills that students have formed Teachers can take the following methods to collect student information: -Interview -Growth record questionnaire method -Observation -Test Method -Homework</p> <p>1.4 Analysing context Drawing upon the cognitive load theory, this study employs the TSCCK model in conjunction with cloud technology for teaching purposes. In order to optimize the effectiveness of this integrated teaching environment, it is critical to ensure the smooth and normal operation of the cloud. To achieve this, the classroom should be evaluated to assess both the ease of utilizing the cloud and the convenience of mobile cloud applications.</p>
2. Design
<p>2.1 Designing Fundamentals of E-commerce data analysis and processing knowledge Instruction</p> <p>2.1.1 Analysing resources Prior to commencing the course, teachers should establish clear learning objectives. To achieve these objectives in the classroom, teachers should identify the necessary learning resources that students require to acquire theoretical knowledge and practical operational skills related to the fundamentals of E-commerce data analysis and processing.</p> <p>2.1.2 Defining fundamentals of E-commerce data analysis and processing instruction characteristics In addition to providing students with learning resources, teachers must also identify the characteristics of tasks and develop a reasonable instructional design to minimize both the intrinsic and extraneous cognitive load of students, so as to minimize their cognitive load and achieve the purpose of improving their academic performance. The followings are E-commerce data analysis and processing instruction characteristics: Learning from Worked-Out Examples and Problem Solving (Van, & Ayres, 2005) This teaching method can reduce students' cognitive load and promote students' learning.</p>

Table 4.4 (Continued)

• **Techniques That Reduce Extraneous Cognitive Load and Manage Intrinsic Cognitive Load during Cognitive load Theory** (Van, & Ayres, 2005)

By leveraging technical support from cloud technology and utilizing appropriate teaching methods, the presentation of learning materials has been modified, resulting in a reduction of both intrinsic and extrinsic cognitive load experienced by students.

This paper presents a sample of learning tasks that embodies the teaching philosophy of the TSCCK model, providing teachers with a practical demonstration of how to deliver the course of E-commerce data analysis and processing knowledge. Please refer to the sample task.

2.1.3 Determining E-commerce data analysis and processing instruction assessment

To achieve the teaching effect, teachers need to evaluate the E-commerce data analysis and processing of teaching, which can be achieved by using the test platform provided by the cloud.

2.2 Developing E-commerce data analysis and processing instruction

2.2.1 Scripting E-commerce data analysis and processing instruction process

In order to achieve a favorable teaching outcome in the course of E-commerce data analysis and processing knowledge, teachers must be guided by relevant theories in addition to the technical support of the cloud. One such theory is cognitive load theory, which is the cornerstone of instructional design. After years of research by scholars, it has been proved that once this theory is applied in teaching, it will have a good impact on teachers' instructional design and students' learning.

2.2.2 Breaking E-commerce data analysis and processing instruction process

It is advisable to break down the scripted E-commerce data analysis and processing instruction by:

Introduction

In the first link of E-commerce data analysis and processing teaching, it is essential for teachers to establish a connection between students' prior knowledge and the course content. Additionally, leveraging cloud technology can aid in reducing students' cognitive load and capturing their attention.

Task

With the aid of cloud technology, students are presented with learning tasks that are both straightforward and easy to operate. This approach, from the perspective of cognitive load theory, effectively reduces students' cognitive load.

Process

During this learning stage, it is crucial for teachers to emphasize key knowledge points and common mistakes to students, enabling them to acquire practical knowledge and successfully complete learning tasks.

Resource

In this stage, the teacher provides students with necessary materials to complete the learning task, such as leveraging cloud support.

Evaluation

Teachers show students the examination system provided by the cloud as an assessment tool, and inform students how the cloud evaluates students' learning.

Conclusion

In the fifth step of learning, the course design also includes providing students with the opportunity for independent practice, allowing them to explore and apply what they have learned. This component of the course design serves to encourage students to actively engage with and practice the material covered in the course.

2.2.3 Revising the teaching process

Teachers may need to revise the teaching design of the fundamentals of E-commerce data analysis and processing to accommodate the individual needs of students. Teaching should be student-centered, and since students are unique individuals with varying characteristics, the teaching design must be flexible and adaptable. As a result, modifications may be necessary at any stage of the teaching process.

Table 4.4 (Continued)

3. Cloud-based learning
<p>3.1 Using the Cloud</p> <p>3.1.1 Opening class</p> <p>The teacher enters the Teacher Space and enters the Teachers Course, clicks the "Add Course" button, fills in the relevant course information in the Pop-up Window, and then clicks "OK" to complete the addition. In the new course, there is Relevant Class Information, and click the Relevant Class Information to add the students in the resource database to the class for teaching, including classroom instruction, Instruction Design, Course content, and requirements, For more details please see chapter 2.</p> <p>3.1.2 The teaching process</p> <p>Before class - students learn independently</p> <p>Before teaching, the technology provided by the cloud can simplify learning tasks and reduce cognitive load. Teachers can let students log on to the cloud in advance and make them complete the tasks assigned by reasonable teaching design by releasing tasks to them. By doing so, students can improve their enthusiasm for learning and also reduce their cognitive load.</p> <p>In class - student task implementation</p> <p>Given the unique nature of computer courses, it is recommended that teachers start with simple knowledge rather than difficult knowledge. For instance, they can introduce the basic functions of Excel first and encourage students to discuss and report on them in groups. As students become more proficient, the level of difficulty can be gradually increased. On the basis of the student's understanding of the basic knowledge of Excel, we gradually increase the difficulty and use of spreadsheet Excel software to solve practical work problems.</p> <p>After class - students design and work</p> <p>Dealing with Expertise Development: Toward Adaptive E-learning (Van, & Ayres, 2005)</p> <p>As educators, it is vital to continuously assess learners' knowledge levels based on their performance and cognitive load and dynamically adjust teaching methods to cater to individual needs. For example, teachers can evaluate students' understanding at any point during the teaching process. Building on students' basic knowledge of Excel, teachers can adopt dynamic teaching methods, utilizing Excel to propose solutions to practical work problems, and requiring students to record videos and upload them to the vocational education cloud.</p> <p>Teachers log on to the vocational education cloud platform to review the design and production of Excel projects. Based on the students' work, they then adjust the subsequent learning activities to ensure effective learning outcomes.</p> <p>Through the utilization of vocational education cloud, students can integrate three kinds of knowledge: student content knowledge (SK), student cognitive knowledge (SCK), and student technology knowledge (STK).</p> <p>Students are capable of constructing the TSCCK framework through the completion of relevant learning tasks.</p>
4. Instruction development
<p>4.1 Designing instructional material</p> <p>4.1.1 Designing learning activities</p> <p>TSCCK model emphasizes that students are the centre of the class. In the process of E-commerce data analysis and processing knowledge teaching, how to attract students' attention is a problem for teachers to consider. In order to enable students to master theoretical knowledge and practical operational knowledge, especially the use of practical operational knowledge to solve practical problems, teachers should consider how to teach students practical operation in the process of teaching; How to provide opportunities for students to operate on their own to help students develop new E-commerce operation skills.</p> <p>The unique goal of The TSCCK model is to enhance students' cognitive load and learning achievement through the application of cloud technology.</p> <p>The following three processes of learning activities are of benefit to teachers:</p> <p>Plan:</p> <p>A plan marks the beginning of everything. Firstly, teachers must comprehend the learning objectives of the course. Subsequently, learning resources are selected based on the learning objectives. Teachers should ensure that the learning resources can help students solve the problems encountered. In addition, teachers should establish the characteristics of the learning tasks, along with the timing, location, and evaluation.</p>

Table 4.4 (Continued)

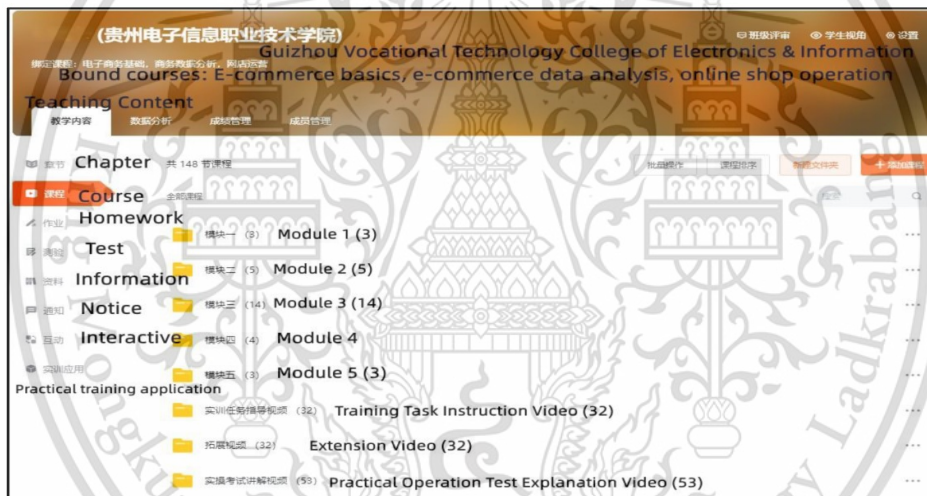
Preparation:
 Prior to formal teaching, teachers must prepare the relevant teaching resources and ensure their proper placement and normal functionality.
 To attain the predetermined learning objectives, teachers must premeditate a rational teaching design, define their and students' roles based on the teaching content, devise appropriate teaching activities, and employ cloud technology to assist in realizing the learning objectives. The following steps can be pursued by teachers to accomplish the learning objectives:
 Teacher's roles

- Teachers elucidate the TSCCK model to students and use cloud technology to employ cloud technology to conduct pertinent learning experiences for them.

During practical implementation, the teacher will establish varying levels of operational tasks based on the students' proficiency, thereby facilitating gradual enhancement of their abilities.

- Teachers provide technical support for students to reduce their cognitive load.


Identification of learning resources that meet the objectives of this course was necessary. These resources encompassed the theoretical knowledge and practical skills required for E-commerce data analysis. To illustrate, the "1+X E-commerce Data Analysis Vocational Skill Level Certificate" offered by Beijing Bo Guiding Future Company was chosen; From the cloud, a webpage containing a list of courses offered in the E-commerce department of our university was accessible. Subsequently, further menus directed us to resources pertaining to these courses (refer to Figure 4.2), which included the backend of the "TaoBao Shop" as depicted in Figure 4.2

**Figure 4.2** Theory and practical training guide video collection

- Teachers provide scaffolding for students at appropriate times.

For example, we taught advertising delivery using "Taobao" (a commercial E-commerce website, <https://world.taobao.com/>, which provides a back end that we were able to access). Through the backend of the "Taobao Shop", students could search the rankings for goods; Figure 4.3 provides an illustration of the output, which comprises substantial real-world marketing data. By examining the detailed data, students were able to obtain a better "picture" of customer needs. This approach facilitated more intuitive and simplified teaching by reducing both the intrinsic and extraneous cognitive load.

Table 4.4 (Continued)



The screenshot shows a Taobao keyword ranking interface. At the top, there is a search bar with the text '同步淘宝网搜索, 请点击查看系统推荐的关键词'. Below the search bar, there are filters for '所有推荐词 > 移动设备' (Total recommended words > Mobile devices) and '共推荐 790' (Total recommended 790). There are also filters for '选择设备: 全部 计算机 移动设备' (Select device: All Computer Mobile devices) and '推荐理由: 全部 热搜词 潜力词 同行词 飙升词 手机标 更多' (Recommendation reason: All Hot words Potential words Peer words Rising words Mobile label More). The main table has columns for 'Keywords', 'Recommended reasons', 'The correlation', 'Exposure Index', 'Average market bid', 'Competition index', and 'Click rate'. Two rows are visible: 'Simple shoe cabinet' and 'Solid wood dining table'.

Keywords	Recommended reasons	The correlation	Exposure Index	Average market bid	Competition index	Click rate	Click conversion
关键词	推荐理由	相关性 ↑	展现指数 ↓	市场平均出价 ↑	竞争指数 ↑	点击率 ↑	点击转化
Simple shoe cabinet << 简易鞋柜	热 机 店	-----	146004	1.13元	1341	6.33%	2.82%
Solid wood dining table << 实木餐桌	热 机	-----	139245	3.25元	2035	5.22%	0.37%

Figure 4.3 Ranking of the various indicators in “Taobao” to teach product promotion.

Through analysis of the detailed data, students were able to obtain a better “picture” of customer needs. This approach simplified teaching by reducing both intrinsic and extraneous cognitive load, rendering it more intuitive and straightforward.

- The teacher facilitated group work among students.
- Additionally, teachers encourage students to work independently, identify and tackle problems, and enhance their practical skills.

Students’ roles

- Students utilize cloud technology to independently perform practical operations and address operational challenges.
- Students self-evaluate their learning progress by completing homework and reviewing scores provided by the cloud platform.
- By assessing their performance on the cloud platform, students recognize the difficulty of the learning process and are motivated to make the necessary efforts to improve.
- By utilizing the cloud-based testing system for continuous learning, students gradually acquire new knowledge.

Following planning and preparation, teachers design various learning activities with the support of cloud technology to enhance students' cognitive load and learning outcomes.

4.1.2 Determining instructional steps

To facilitate seamless implementation of cloud-supported E-commerce data analysis and processing learning activities, teachers must design the steps of learning process in a rational manner. This will not only reduce the cognitive load of students but also stimulate their interest in learning.

4.1.3 Designing assessment

Teachers can use the technical support provided by the cloud to evaluate the students’ situation during the learning process. The cloud system will record, for example, the completion of each student’s automatic homework, check-in status, whether they arrive late or leave early, and answer questions quickly. These indicators can serve as formative assessments and contribute toward usual grades. Additionally, student mid-term and final exam scores can be automatically displayed on the cloud platform for summative evaluations.

4.2 Developing instructional materials

4.2.1 Using the electronic classroom

During practical operation instruction, teachers can utilize electronic classroom functions to control the screen and provide explanations while demonstrating operations. Students can directly observe the teacher's operations on the monitor in front of them, using the Starscream electronic classroom control screen (Hou,2011). Upon completion of the demonstration, the teacher can release control to allow students to perform the operations independently.

4.2.2 Developing Online shopping operation test and WP scale

The assessment items are as follows:

E-commerce test -- Multiple choice question;

WP scale -- Cognitive load test;

The test covers a range from theoretical knowledge to practical operations, reflecting the learning objectives of the course.

Table 4.4 (Continued)

<p>4.2.3 Developing the lesson plan The following are the instructional steps for the TSCCK model.</p> <p>Step 1. Activate the students' personal prior knowledge 1.1 Subject Teaching 1.2 Reduce students' cognitive load</p> <p>Step 2. Guiding the students 2.1 Task Introduction 2.2 Guiding student's actual operation</p> <p>Step 3. Deal with the operational tasks 3.1 The opportunity 3.2 Presentation</p> <p>Step 4. Instruct the operation tasks</p> <p>Step 5. Assign new operation tasks</p> <p>4.4 Assessing the TSCCK instruction Assessment is a better way to achieve learning objectives. Without evaluating the effectiveness of a good teaching model, teachers will be uncertain whether the learning objectives and outcomes have been met. Thus, assessment is necessary to determine whether the learning objectives have been achieved. To determine the effectiveness of a teaching model, the MANOVA method can be used to analyze student test results. A good model that can withstand the test of time is the result of continuous revision by researchers. In the course of teaching, students' responses serve as the best test of the model's effectiveness. Hence, teachers can revise and improve the model to enhance students' learning outcomes.</p>
<p style="text-align: center;">5. Model Implementation</p> <p>This step involves the practical implementation of E-commerce data analysis and processing course instruction by teachers. It includes preparing for instruction delivery, such as arranging the classroom setting and providing appropriate learning materials, to ensure an authentic and meaningful learning experience for students. The following are suggested instructional steps that teachers can use to apply their E-commerce data analysis and processing course instruction in the classroom.</p> <p>Study the effect of the TSCCK instruction The following steps outline the specific implementation process of computer teaching for teachers using the TSCCK model. This includes the provision of teaching resources for students, such as learning materials and the use of electronic classrooms. It involves the following steps:</p> <p>Step 1. Stimulate the students' personal prior knowledge Before formal teaching, it is essential for teachers to capture the attention of students. Teaching methods such as the question-and-answer method and brainstorming can be utilized to connect students' prior knowledge with the upcoming course material. Additionally, cloud technology can be used to capture students' attention and reduce cognitive load.</p> <p>1.1 Subject Teaching During the class, the teacher should inform the students of what will be learned in the class, as well as the learning objectives and expected learning outcomes.</p> <p>1.2 Reduce students' cognitive load Teachers employ the vocational education cloud to deliver E-commerce data analysis and processing-related knowledge to students. Students can access the cloud and use the electronic classroom to simplify the information, making it easy to understand and operate, thereby reducing their cognitive load.</p> <p>Step 2. Guiding the students In the first step of teaching, teachers stimulate students' interest in learning. In the subsequent stage, teachers inform students of the learning tasks and rules that need to be completed.</p> <p>2.1 Task Introduction During the process of teaching, the teacher will initially clarify the learning objectives of the class to the students. It is imperative for the students to attentively listen to the instructor and adhere to the teaching methods presented.</p> <p>2.2 Guiding student's actual operation Throughout this learning process, the teacher uses technology and concise language to impart knowledge to the students in the classroom. The students attentively listen to the instructor and execute pertinent tasks in accordance with the teacher's directives.</p>

6. Model Revision

To evaluate the effectiveness of the model, teachers may analyze the results of the WP scale and E-commerce data processing test.

It is important to note that revision is an ongoing process, and whenever instructors identify challenging or unclear components in the learning process, adjustments must be made to improve teaching efficacy and help students achieve instructional objectives.

Table 4.5 Sample of students' activities

Learning theme	Complete customer service data analysis																														
Collaborative Learning Tasks (Students)	<p>With the rise of online shopping, the role of customer service staff in physical stores has become crucial in the overall shopping experience. The conversion rate of consultations provided by customer service staff has a significant impact on store sales. Therefore, the teacher provided guidance and assistance to students in evaluating the performance of customer service staff through data analysis in this task.</p>																														
	<p>Case: a Taobao shop specializing in women's clothing has 3 customer service staff. In order to improve the performance of the entire customer service team, the manager decides to track the consulting conversion rate of customer service and take it as the focus of the KPI assessment.</p> <p>Students are required to:</p> <ol style="list-style-type: none"> Data query According to the commodity sales platform, determine the data source, such as sales in the Taobao platform. In the Taobao business platform "my worktable-business growth", in the left column of "customer service", you can query the shop inquiry single conversion rate. Determine the collection indicators This task includes the collection of three key data, namely Want Want consulting rate, Want Want consulting conversion rate and access depth. In addition, it should also include the number of page views, the number of visitors and other indicators. Make a data collection table Make a data collection table based on the collection indicators determined in Step 2, as shown below <table border="1" style="margin-left: auto; margin-right: auto;"> <thead> <tr> <th>Date</th> <th>Views</th> <th>Visitor number</th> <th>Access depth</th> <th>Want Want consultation rate</th> <th>Want Want consulting conversion rate</th> </tr> </thead> <tbody> <tr> <td>Today</td> <td>2399</td> <td>610</td> <td>2.34</td> <td>36.22%</td> <td>16.06%</td> </tr> <tr> <td>Yesterday</td> <td>1999</td> <td>553</td> <td>1.89</td> <td>29.13%</td> <td>13.33%</td> </tr> <tr> <td>Same period last week</td> <td>2039</td> <td>400</td> <td>1.62</td> <td>25.75%</td> <td>12.89%</td> </tr> <tr> <td>Weekly mean</td> <td>2142</td> <td>571</td> <td>1.75</td> <td>29.56%</td> <td>13.78%</td> </tr> </tbody> </table> <ol style="list-style-type: none"> Make a bar chart of access depth "Access" depth refers to the number of consecutive pages a visitor views during a single session, indicating the extent to which they explore the website. On the other hand, the "average access depth" is the mean number of consecutive pages viewed by visitors per store. The figure below illustrates the statistics of visit depth for the store. 	Date	Views	Visitor number	Access depth	Want Want consultation rate	Want Want consulting conversion rate	Today	2399	610	2.34	36.22%	16.06%	Yesterday	1999	553	1.89	29.13%	13.33%	Same period last week	2039	400	1.62	25.75%	12.89%	Weekly mean	2142	571	1.75	29.56%	13.78%
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Table 4.5 (Continued)

Learning theme	Complete customer service data analysis																														
	<div data-bbox="488 306 1295 701" style="text-align: center;"> <table border="1" style="margin: auto;"> <caption>Customer Service Data Analysis</caption> <thead> <tr> <th>Period</th> <th>Value</th> </tr> </thead> <tbody> <tr> <td>Today (今日)</td> <td>2.34</td> </tr> <tr> <td>Yesterday (昨日)</td> <td>1.89</td> </tr> <tr> <td>Same period last week (上周同期)</td> <td>1.62</td> </tr> <tr> <td>Daily mean (日均值)</td> <td>1.75</td> </tr> </tbody> </table> </div> <p data-bbox="472 730 1354 785">5. Make the change chart of the Want Want consultation rate and Want Want consultation conversion rate</p> <p data-bbox="472 789 1354 873">Want Want consulting conversion rate refers to the ratio of the number of customer service transactions through Ali Want Want consulting and the total number of consulting, namely:</p> <p data-bbox="472 877 1235 905">Want Want consultation rate = Want Want consultation number/total visitors</p> <p data-bbox="472 909 1354 963">Want Want consulting conversion rate = Want Want consulting transaction number/Want Want consulting total number</p> <p data-bbox="472 968 1354 1104">The following figure shows the change in the Want Want consulting rate and Want Want to consulting conversion rate of the store. As can be seen from the figure: with the change of the depth of access, the Want Want consulting rate and the Want Want consulting conversion rate change accordingly; The greater the value of access depth, the greater the Want Want consulting rate and Want Want consulting conversion rate.</p> <div data-bbox="488 1108 1354 1640" style="text-align: center;"> <table border="1" style="margin: auto;"> <caption>Want Want Consulting Rate and Conversion Rate Analysis</caption> <thead> <tr> <th>Period</th> <th>Access depth</th> <th>Want Want consultation rate</th> <th>Want Want consulting conversion rate</th> </tr> </thead> <tbody> <tr> <td>Today (今日)</td> <td>2.34</td> <td>35.22%</td> <td>16.05%</td> </tr> <tr> <td>Yesterday (昨日)</td> <td>1.89</td> <td>32.13%</td> <td>13.33%</td> </tr> <tr> <td>Same period last week (上周同期)</td> <td>1.62</td> <td>25.75%</td> <td>12.89%</td> </tr> <tr> <td>Daily mean (日均值)</td> <td>1.85</td> <td>29.56%</td> <td>13.78%</td> </tr> </tbody> </table> </div> <p data-bbox="472 1669 873 1696">6. Set customer service KPI assessment</p> <p data-bbox="472 1701 1354 1755">The consulting conversion rate evaluation table formulated by the store for customer service KPI assessment is shown in the following table.</p>	Period	Value	Today (今日)	2.34	Yesterday (昨日)	1.89	Same period last week (上周同期)	1.62	Daily mean (日均值)	1.75	Period	Access depth	Want Want consultation rate	Want Want consulting conversion rate	Today (今日)	2.34	35.22%	16.05%	Yesterday (昨日)	1.89	32.13%	13.33%	Same period last week (上周同期)	1.62	25.75%	12.89%	Daily mean (日均值)	1.85	29.56%	13.78%
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Table 4.5 (Continued)

Learning theme	Complete customer service data analysis																												
<p data-bbox="472 300 1364 357">KPI assessment index</p> <p data-bbox="472 357 1364 579">Transaction conversion rate(\times)</p>	Calculation formula	Scoring criteria	Score	Weights																									
	$\text{Consultation conversion rate} = \frac{\text{Number of transactions}}{\text{Total number of consultations}}$	$X \geq 41\%$	100	30%																									
		$38\% \leq X < 41\%$	90																										
		$35\% \leq X < 38\%$	80																										
		$32\% \leq X < 35\%$	70																										
		$28\% \leq X < 31\%$	60																										
		$25\% \leq X < 28\%$	50																										
$X < 25\%$		0																											
	<p data-bbox="472 613 1364 690">The consulting conversion rate of three customer service staff in the store in the recent 30 days is shown in the following table.</p>																												
	<table border="1" data-bbox="516 695 1341 877"> <thead> <tr> <th>Consumer service staff</th> <th>Total number of transactions</th> <th>Total number of consultants</th> <th>Transaction conversion rate</th> <th>Score</th> <th>Weighted score</th> </tr> </thead> <tbody> <tr> <td>A</td> <td>88</td> <td>275</td> <td></td> <td></td> <td></td> </tr> <tr> <td>B</td> <td>582</td> <td>1455</td> <td></td> <td></td> <td></td> </tr> <tr> <td>C</td> <td>232</td> <td>800</td> <td></td> <td></td> <td></td> </tr> </tbody> </table>					Consumer service staff	Total number of transactions	Total number of consultants	Transaction conversion rate	Score	Weighted score	A	88	275				B	582	1455				C	232	800			
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	<p data-bbox="472 1222 1364 1339">Conclusion: Customer service B has the highest turnover rate, followed by customer service A and customer service C. Turnover rate can directly reflect the quality of a customer service staff. Under the same conditions, the higher the turnover rate, the more outstanding the contribution to the store.</p>																												
The scaffold	<p data-bbox="472 1339 1364 1482">In the process of task implementation, the teacher can provide the account and password of the store background login, and students can inquire about the conversion rate of store inquiry by themselves after login. When it is challenging to master the function (such as VLOOKUP), the teacher should provide some learning videos or live demonstrations answering questions.</p>																												

Table 4.5 (Continued)

Learning theme	Complete customer service data analysis
Evaluation criteria	<p>Finally, according to the requirements of the teacher, everyone submits the homework in the form of attachments through the vocational education cloud (as shown in the following figure). The students cross-evaluate each other, and the teacher makes the final evaluation. The evaluation standard is whether the students complete each step and the correct rate.</p> 

4.3 The results of the effect of the TSCCK model with a cloud based on cognitive load theory to enhance Vocational students' cognitive load and learning achievement.

The effect of the TSCCK model with a cloud to enhance Vocational students' cognitive load and learning achievement

A total of 62 students were randomly selected from 115 vocational students at a college in GuiZhou Province, China, using cluster random sampling. The experiment was conducted in an electronic classroom, and the lesson plans were verified. The TSCCK model was utilized to evaluate its impact on the cognitive load and learning ability of vocational students. The experiment yielded the following results.

Table 4.6 Testing the dependent variables.

	Box's M Test (Sig)	Bartlett's Test (Sig)
Learning achievement And_cognitive load	0.068	<0.001

To confirm that the differences were statistically valid, we used a MANOVA to test the two dependent variables, i.e., learning achievement and cognitive load. We started with Bartlett's test of sphericity, which reported <0.001 (Table 4.6), indicating that learning achievement was strongly correlated with cognitive load. To further

validate our findings, we also performed a Box M test, which showed no significance with a Sig value greater than α . All variance- covariance matrices in population are equal.

Table 4.7 MANOVA test results classified by group.

Group	Pillai's trace	0.902	270.406 ^b	<0.001
	Wilks' lambda	0.098	270.406 ^b	<0.001
	Hotelling's trace	9.166	270.406 ^b	<0.001
	Roy's largest root	9.166	270.406 ^b	<0.001

^b Exact statistic.

Table 4.7 highlights that Wilks' lambda, Hotelling's trace, Pillai's trace, or Roy's largest root were employed in the MANOVA to evaluate the significance of differences between the TSCCK group and the control group, as depicted by the F statistics. The significance level (Sig > α), as presented in Table 4.6, was set at $\alpha = 0.05$. Furthermore, Bartlett's test of sphericity was <0.0005, or statistically significant, confirming a high correlation and the suitability of the prediction (Hair, Howard, & Nitzl, 2020). In Table 4.7, Wilks' lambda had sig < 0.001, or much less than our $p < 0.05$, again confirming that the TSCCK model had at least one variable that differed from the traditional group. The MANOVA results appear in the final columns of Table 4.8 These tests confirmed a statistically significant difference in learning achievement and cognitive load between the groups.

Table 4.8 Learning achievement and cognitive load after course completion.

Variables		N	\bar{x}	Shapiro-Wilk		F	Sig	Levenne Test	SD	Med
Dep	Ind			W	p					
Learning achievement	TSCCK	31	55	0.909	0.012	67.684	0.000	<0.001	25	52.0
	Control	31	10	0.657	0.000				16	4.0
Cognitive load	TSCCK	31	32	0.924	0.030	393.80	0.000	0.025	5	31.0
	Control	31	53	0.959	0.270				3	53.0

\bar{x} , mean; SD: standard deviation; Med: median; W: Shapiro-Wilk W; p: Normality probability; F: F distribution; Sig: significance (from the MANOVA)

Two tests were conducted to compare the data of the experimental group and control group at a significance level of 0.05. Table 4.8 presents the results of these tests. Initially, means and standard deviations were computed, and the Shapiro-Wilk test revealed high skewness in the distributions. Consequently, medians (indicated by Med) were computed and used as the primary basis for the comparison. For learning achievement, the TSCCK group (mean = 55, SD = 25, Med = 52.0) had a better (i.e., higher) score than the control group (mean = 10, SD = 16, Med = 4). For cognitive load, the TSCCK group (mean = 32, Med = 31.0) also had better (lower) WP scores

than the control group (mean= 53, Med = 53). We note that the TSCCK approach yielded significant benefits, likely due to a combination of factors. However, we attribute most of the benefit to the reduction in cognitive load, as it was clearly significantly lower. Although the overall improvement in the median score was evident, it was not uniform across all students, and some benefited more than others. This will be further elaborated in the conclusion section. According to several studies (Hair, Howard, & Nitzl, 2020; Islam,2018), it is reasonable to assume normality and use a MANOVA to confirm that our sample distributions were significantly different, given a sample size larger than 30.



CHAPTER 5

SUMMARY, DISCUSSION, AND RECOMMENDATIONS

This thesis entitled " Modeling Students' Technology, Cognitive and Content Knowledge (TSCCK) with a Cloud to enhance Vocational Students' Cognitive Load and Learning Achievement", consists of three objectives, which are:

- 1) To find the status of the Chinese Vocational students' technology, cognitive and content knowledge (TSCCK) with a cloud.
- 2) To develop the TSCCK model with a cloud to enhance the cognitive load and learning achievement of Chinese Vocational students.
- 3) To find the effect of the TSCCK model on the cognitive load and learning achievement of Chinese Vocational students.

5.1 SUMMARY

The summary of this study is presented in three sections:

Section 1. The results of the status of the Chinese Vocational students' technology, cognitive and content knowledge (TSCCK).

Section 2. The results of the development of the TSCCK model with a cloud based on cognitive load theory to enhance Chinese Vocational students' cognitive load and learning achievement.

Section 3. The result of the effect of the TSCCK model with a cloud based on cognitive load theory to enhance Chinese Vocational students' cognitive load and learning achievement.

5.1.1 The results of the status of the Chinese Vocational students' technology, cognitive and content knowledge (TSCCK).

To achieve the purpose of the study, the researchers read a large number of references and related professional books and magazines, especially those on cognitive load theory, before the study officially started. We used a questionnaire (5-point Likert scale) to investigate the current status of E-commerce major students' technology, cognitive load and content knowledge, summarized by Mean and Standard Deviation. As can be seen from the test results from (Table 4.1), part one: mean=4.3, SD=0.5 and part two: mean=4.2, SD=0.6, means that the students' current status of technology, cognitive and content knowledge were at agree and good level.

5.1.2 The results of the development of the TSCCK model with a cloud based on cognitive load theory to enhance Chinese Vocational students' cognitive load and learning achievement.

Step 1: To develop, assess and evaluate the TSCCK model with a cloud for Chinese Vocational students

Based on cognitive load theory and cloud technology, the TSCCK model is developed, on the purpose to improve students' learning achievement and reduce cognitive load. In teaching design, the two learning methods of five learning steps from Chao (2020), Gao (2008) and Gagné' et al. (1992). learning are combined to clarify the principles and learning steps of the newly developed teaching model. The model was implemented with cloud technology, which greatly enhances students' enthusiasm for learning. I used the focus group to provide expert guidance on the research instrument. As can be seen

from the (table 4.2), the overall mean was 4.65 and SD=0.52. Through guidance from the focus group, the TSCCK model consistency, validity, and appropriateness has been greatly improved and enhanced.

Step 2: Find the efficiency of the TSCCK model with a cloud for Chinese Vocational students

Based on the opinions of the instructor and the verification of experts, the newly developed teaching model, teaching materials, and documents had been revised and improved. In terms of structure validity, the teaching model, teaching materials, and literature were all verified by five experts in related fields.

After revising the TSCCK model and related materials and documents using expert opinions, toward the model and related materials and documents were verified again. Then, before the actual implementation, the TSCCK model and related documents were revised and improved again.

In order to enable the TSCCK model to be successfully implemented, we selected 10 Chinese Vocational students in E-commerce, and carefully developed the lesson plan, which consists of the title, class hours, learning objectives, learning process, evaluation, and other parts. Use the cloud for teaching and provide technical support for learning activities, the WP scale and the E-commerce test were also developed during this period. Over 80% of the students' learning achievement met the passing grades at low cognitive load levels (Tsang & Velazquez, 1996) (Table 3.11 and Table 3.12).

5.1.3 The results of the effect of the TSCCK model with a cloud based on cognitive load theory to enhance Chinese Vocational students' cognitive load and learning achievement.

This research used the quasi experiment design to study the effect of the TSCCK model on the cognitive load and learning achievement of Chinese Vocational students. The sample of this study was 62 Vocational students, majoring in E-commerce in the second semester of the 2021-2022 academic year.

In order to study the effect of the TSCCK model with a cloud on the cognitive load and learning achievement of Chinese Vocational students, this study used the WP scale and E-commerce test as measurement tools. The WP scale includes seven parts: Central processing resources, Response resources, Spatial coding resources, Language coding resources, Visual reception resources, Auditory reception resources, and Operational resources. For E-commerce test, three experts in related fields verified the structural validity and content validity of the test. Then, before using by 62 Chinese Vocational students, the test was further modified using expert feedback and test blueprint guidelines.

The implementation process of the teaching mode of the TSCCK model based on the cognitive load theory is as follows: (1) using the WP scale to measure the cognitive load of students, (2) using the E-commerce course teaching developed by the TSCCK model with a cloud to test students' E-commerce operation ability, (3) analyzing the results of the two tests by MANOVA. Then, the influence of the TSCCK model used in a cloud was determined.

According to the result (Table 4.6, Table 4.7 and Table 4.8), the MANOVA confirmed that both the achievement scores and cognitive load measures for the two groups were significantly different at the 0.05 level.

5.2 DISCUSSIONS

5.2.1 The current status of the Chinese Vocational students' technology, cognitive and content knowledge (TSCCK).

Vocational education is training practices that equips individuals to operate as technicians as tradespeople or artisans in a skilled craft or trade. Vocational education may also be thought of as the sort of education provided to a person in order to prepare them for gainful employment or self-employment with the necessary skills (Lawal, 2013). High vocational education is a crucial component of high education and falls under the category of high education. However, it differs from regular high education in that it should adapt to the changing needs of society and the economy and the skills that are developed should be in line with the demands of the labour market, the needs of the workplace, and the advancement of society and the economy as a whole. With the continued advancement of modern science and technology, high vocational education mandates teachers to integrate modern science and technology into vocational education in the learning process. The primary distinction between vocational education and high education is the focus point. Vocational education focuses on developing practical technical talents, emphasizing practical skills, and solving practical problems in the production process. The feasibility of implementing practical vocational education in high education institutions was examined by Dongning and Bo (Dongning & Bo, 2022). To confirm the viability of implementing practical vocational education in high education institutions, an optimized BPNN was used to predict the impact of practical vocational education on vocational college students. They use artificial intelligence, virtual reality technology to improve the immersion of art education, change the conventional high vocational art teaching mode, and significantly increase the effectiveness of high vocational art teaching (Qingyun, 2022). As we know, many vocational schools use modern technology in their teaching, so we formulated the discussion question in the present study as follows:

What is the current status of the Chinese vocational students' technology, cognitive and content knowledge (TSCCK)?

According to the result of the questionnaire (5 points Likert scale), the mean score for part one was 4.3 with a standard deviation (SD) of 0.5, while for part two, the mean score was 4.2 with an SD of 0.6, it means that students' technology, cognitive and content knowledge (TSCCK) in the cloud were agree and good. Thus, it means that the status of the Chinese vocational students' technology, cognitive and content knowledge (TSCCK) in some extent was agreed. In other words, it accordance with some researchers' opinions that using virtual reality technology can significantly improve the traditional, inappropriate, and ineffective training system of innovative education in high vocational colleges, break the constraints of time and space, lower the cost, and improve the status quo of innovation education in high vocational colleges (Man, Guo, & Ma, 2020).

5.2.2 The development of the TSCCK model with a cloud based on cognitive load theory to enhance the Chinese Vocational students' cognitive load and learning achievement

The cloud, namely the construction and application platform of the professional teaching resource base, is based on the functional positioning of the

vocational education major teaching resource base on the project of the Ministry of Education of China, and in accordance with the requirements of the Manual of Professional Education Teaching Resource Base Construction (Gao, 2020), the integrated design of structured curriculum granularity resources is carried out.

The construction logic of a professional teaching resource database is based on the online teaching platform of teachers and students. It provides operating platform support for colleges and universities to apply for national and provincial professional teaching resource database projects and, at the same time, opens university characteristic professional resource database or online open course construction results to the whole society.

The cloud is based on schools, and every teacher has a corresponding account and permission when using the cloud for teaching. Specifically, it can be divided into three parts: before class, during class, and after class (Li, Mao, & Yang, 2017).

Before class, teachers can get free teaching information resources on the cloud and combine the two according to their own classroom content.

In class, teachers make use of the relevant resources and functions of the cloud to conduct information teaching for students, such as checking-in, brainstorming, and playing animated videos on the platform.

After class, teachers can conduct relevant tests and homework, and the system will automatically record students' learning tracks.

Cognitive load theory (Plass, Moreno & Brünken, 2010) is a theory that promotes learning and teaching design based on the results of modern cognitive psychology research. It has a wide range of application capabilities, operational value, and positive development prospect. It is divided into: intrinsic cognitive load, extraneous cognitive load, and germane cognitive load. An effective teaching design can reduce the extraneous cognitive load while increase the relevant cognitive load. The TSCCK model in this study is a exemplary teaching design.

The cognitive load theory based on technology support was increasing year by year, for examples:

The application of artificial intelligence (AI) in education often leads to cognitive load, and they explore the impact of gender differences on primary school students with the example of a game-based Chinese idiom learning intelligent robot. The study combined games and Zenbo robots to teach primary school students how to use Chinese idioms. The results showed that the system was more beneficial for boys because they had significantly lower cognitive load, showing a positive cognitive load (Beyin et al., 2021). There are two types of digital video namely linear video and interactive video. Also, using the 'auto-pause' strategy or 'interactive questions' in the interactive video has an effect on increasing learners' interaction with content, which reduced the intrinsic cognitive load for students of the experimental group who used short videos. This is affirmed by Afify (2020) who noted that the interaction of students with the video and their engagement in the learning process, and that using short videos could reduce the cognitive load for learners. Giving students a longer unrestricted interaction with the AI book revealed relationships between cognitive load, usability perception, self-regulation, cognitive strategy use, learning gain and book features (Marta et al., 2022). Based on cognitive load and game design theory, a simple interactive math game is developed to enable players to solve math problems competitively and creatively. The results of the study suggest that MATHERIAL players demonstrated higher math achievement than their peers

who did not play. In addition, others' findings reveal that computer games can have a positive effect on students' performance in math (Es, Abdelghani, & Paas, 2020). Tinker Plots is a great piece of software and the approach is informed by the recommendations of the Guidelines for GAISE (Assessment and Instruction in Statistics Education) report as well as research on Universal Design and Cognitive Load Theory, and it has shown promise in supporting college students with disabilities learning statistics (Ibrahim, & Michelle, 2022). This research develops a virtual reality (VR) system that allows learners to travel in spacecraft at close to the speed of light for space exploration and to learn about the concept of special relativity and mass-energy equivalence. The experimental results show that the learning efficiency of the experimental group was higher than that of the controlled group, while the cognitive load of the experimental group was lower than that of the controlled group (Wernhuar et al., 2022).

Quasi-experiment is used to study how EIA (Experience-Inquiry-Application) model and AR learning environment affect students' science learning. Quantitative data showed that students who participated in the EIA model performed best in the AR setting. The results showed that both the environmental impact assessment model and the augmented reality environment had significantly positive effects on students' science learning performance and reduced their cognitive load (Yang et al., 2021). The researchers used an interactive PDF form in conjunction with the learning management system Ilias to address the twin challenges of avoiding unnecessary stress on students' working memory and minimizing the possibility of cheating by choosing simple test designs. The results showed that the use of interactive PDF forms reduced the additional cognitive load on students, improved the efficiency of teacher marking, reduced the error rate in marking, and further provided faster feedback to students (Imke et al., 2022). The researchers examined a study assessing the cognitive load and productivity effects of human chatbot interactions in a real-world corporate environment. A/B testing software interacting with Software + chatbot, NASA TLX used to assess and compare cognitive load between two user groups. The results showed that chatbot users had less cognitive load and were more productive than software-only users (Schmidhuberet al., 2021).

TSCCK model includes Student Technology Knowledge (STK), Student Content Knowledge (SK), and Student Cognitive Knowledge (SCK). With the support of the cloud, if teachers adopt appropriate teaching methods, Knowledge in these three aspects can be developed to a certain extent, especially based on Cognitive load theory.

To sum up, the TSCCK model based on cognitive load theory aims to enhance the Vocational students' cognitive load and learning achievement. This model consists of six significant steps which are 1) analysis, 2) design, 3) cloud-based learning, 4) instruction development, 5) model implementation, and 6) model revision.

5.2.3 The effect of the TSCCK model with a cloud based on cognitive load theory to enhance the Chinese Vocational students' cognitive load and learning achievement

The results showed improvement in students' cognitive load and E-commerce test scores, which can be regarded as two indicators of the impact of the TSCCK teaching model. From MANOVA, the E-commerce test and the WP scale in the instructional model were significantly different at the 0.05 level. This

suggested the TSCCK model does have a positive effect on the student's cognitive load and learning achievement. Such positive effects may result from contributory factors of the study.

According to Miller's (1956) earlier work, Cognitive Load Theory (CLT) suggested that using the right technology would reduce cognitive or physical work and increase productivity.

Mostafa and Abu (2022) showed the use of instructional design models: ADIDAS (Analyse (A), Design (D), Improve (I), Do (D), Assess (A), and Share (S)) for SDL (Synchronous Digital Learning) contributes to digital learning sustainability during the COVID-19 pandemic, and that the students' cognitive load and attitudes towards SDL were better after adopting the ADIDAS model. Schmidhuber and others (2021) has showed that chatbot interaction can produce less cognitive load than software interaction, in addition to further potentially improving productivity. Qingyun (2022) also showed that the application of virtual reality technology in teaching management, it can not only provide students with a variety of scenarios for teaching design but also allow students to communicate in real time so that students and teachers can learn from each other through the network anywhere. The TSCCK model with a cloud led to the enhancement of the students' cognitive load and learning achievement. As the students were taught with instruction that was carefully designed and developed following the steps presented in the TSCCK instructional design model where the theory of cognitive load theory approach was the core. The learning tasks of the instruction gave students an authentic learning experience that made students find learning more meaningful as they saw the possibility of using the E-commerce knowledge in their daily life, which, in turn, enhanced their ability to apply learning contents.

5.3 RECOMMENDATIONS

5.3.1 Recommendations for implementation

(1) Model use recommendation

Vocational education Cloud was a very effective teaching resource platform. As we know, vocational education had many different majors, such as Electrical automation technology, Project cost, Film and television animation, Equipment manufacturing et al.; I expect that more and more different majors and fields can use vocational education cloud for learning activities in the future.

(2) Teaching design recommendation

The data concludes that the TSCCK model with a cloud can be satisfied and applied to college students in different genders, different ages and different majors at any times, anywhere and in any way. Students over the age of 18 are the primary learning group. However, it should be noted that, 1) because the TSCCK model with a cloud can be switched at will on mobile phones or computers to meet learners' learning requirements at different times, different from traditional teaching methods, the TSCCK model with a cloud can make full use of modern technology to impart knowledge to students in the teaching process, and emphasize the application of technology. Learners can feel more direct and dynamic video, voice, and practical operational system. but the final control of these all would depend on the teacher's good instructional design (the TSCCK model with a cloud), 2) to achieve the expected teaching effect,

teachers should not only organize and manage students according to the course content but also observe students' learning interests and adopt student-centred teaching methods to achieve the expected learning objectives of the TSCCK model with a cloud.

5.3.2 Recommendations for future study

(1) Use the TSCCK model with a cloud to continuously improve and promote the ability of vocational college students to use technology

As the application of the TSCCK model with a cloud to enhance students' learning achievement and cognitive load is an important way and means to improve students' technical ability through the combination of instructional design and technology. By strengthening and regulating learning activities through technology, students can divide in groups, cooperate and compete in the learning process. Teachers' timely guidance can help students focusing more on the practical operation and application of technology in the learning process, to avoid only attaching importance to the teaching of theoretical knowledge while neglecting the cultivation of practical operational skills.

(2) Maintain TSCCK model with a cloud strategy

To maintain the teaching approach of the TSCCK model with a cloud, the suggestions are; 1) to further optimize, integrate and extend the TSCCK model with a cloud, and expand its scope of use in vocational colleges. 2) to optimize and integrate the techniques of the TSCCK model with a cloud to enhance its learning effect.

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APPENDIX

Appendix A: Certification

Appendix B: List of experts: quality instruments

Appendix C: WP scale

Appendix D: E-commerce test

Appendix E: Test Blueprint

Appendix F: E-commerce data analysis and processing teaching design

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Appendix A

Certification



School of Industrial Education and Technology
King Mongkut's Institute of Technology Ladkrabang
Announcement of the result of thesis proposal examination

School of Industrial Education and Technology with the agreement of thesis proposal examination committees would like to announce the list of thesis title and thesis proposal of Doctor of Philosophy in Technology-Enhanced Learning and Innovation program approved on January 10, 2022 as follows:

Ms. Qiong Wu student ID 62603105 whose thesis title's is "Modeling Students' Technology, Cognitive and Content Knowledge (TSCCK) through a cloud platform to enhance Vocational Students' Cognitive Load and Learning Achievement" with Asst. Prof. Dr. Sirirat Petsangri as the advisor and Asst. Prof. Dr. Thanin Ratanaolarn as the co-advisor.

To ensure that student can complete the research and thesis in time with the assistance of the advisor according to the regulations of King Mongkut's Institute of Technology Ladkrabang.

Announced on January 19, 2022

(Associate Professor Dr. Kitipong Mano)

Dean of the School of Industrial Education and Technology

2022/01/19 Time 16:06:53 | Non-PKI Server Sign-LN
Signature Code : NAA1A-DQAOA-AyADY-AQyBC

Appendix B

List of experts: quality instruments

(TSCCK model)

Table B.1 List of experts about the TSCCK model

Professor.Xiaoying Wu	Research on Education Assessment GuiZhou Education University.China
Asst. Prof.Yuan Dong	Tourism Resource Development Chongqing University of Education.China
Asst. Prof.Weï Tang	Computer Application Research GuiZhou Kaili University.China
Director of the Teaching and Research Section Shoufeng Wu	Engaged in E-commerce Teaching Research GuiZhou Vocational Technology College of Electronics & Information.China
Asst. Prof. Yun Pan	Information Literacy Research GuiZhou Kaili University. China

Table B.2 List of experts about the E-commerce test and the WP scale

Asst. Prof.Weï Tang	Computer Application Research GuiZhou Kaili University, China
Director of the Teaching and Research Section Shoufeng Wu	Engaged in E-commerce Teaching Research GuiZhou Vocational Technology College of Electronics & Information, China
Asst. Prof. Xianping Cao	Information Literacy Research GuiZhou Kaili University, China

Appendix C

WP scale

The scale has seven dimensions, and the following is the operational definition of each dimension:

Table C.1 Seven dimensions of the WP scale

Name of dimension	Meaning of dimension
Central processing resource	The mental resources you have consumed in the process of task selection and execution
Response resources	You feel the mental resources consumed by responding to the task
Spatial coding resources	The mental resources consumed by the spatial activity of your brain during the task
Language coding resources	The mental resources consumed by the speech activity of your brain in the process of completing the task
Visual reception resources	The mental resources you have used to get information from visual channels while completing a task
Auditory reception resources	The mental resources consumed by you to obtain information from the auditory channel in the process of completing the task
Operational resources	In the process of completing the task, you feel the impact of operating your own limbs on the cognitive load

In the task just now, how much mental resources have you invested? Please select the number that suits you after the corresponding psychological resources according to your actual situation, and mark the corresponding position. Among them, "0" means that the resource is not occupied at all, and "10" means that the resource is completely occupied.

0. Not at all/1.very, very low occupancy/2. very low occupancy/3. low mental effort/4. rather low occupancy/5. neither low nor high occupancy/6. rather high occupancy/7. high occupancy/8. very high occupancy/9. very, very high occupancy/10.very, very ,very high occupancy

Table C.2 Scores of the WP scale

Name of dimension	Score range										
Central processing resource	0	1	2	3	4	5	6	7	8	9	10
Response resources	0	1	2	3	4	5	6	7	8	9	10
Spatial coding resources	0	1	2	3	4	5	6	7	8	9	10
Language coding resources	0	1	2	3	4	5	6	7	8	9	10
Visual reception resources	0	1	2	3	4	5	6	7	8	9	10
Auditory reception resources	0	1	2	3	4	5	6	7	8	9	10
Operational resources	0	1	2	3	4	5	6	7	8	9	10

Appendix D

E-commerce test

1. The following operating index system belonging to product operation is (AD).
 - A. Order turnover rate
 - B. Activity participation rate
 - C. Activity ROI
 - D. Product process transformation
2. The data indicators that have a significant impact on sales are (ABC)
 - A. Conversion rate
 - B. Unit price of passenger
 - C. UV
 - D. Return on investment
3. The following indicator system belonging to the user operation is (BCD).
 - A. income
 - B. Losing users
 - C. Login user
 - D. Newly registered user
4. The value of E-commerce data operation includes (ACD).
 - A. Know the user
 - B. Stealing secrets
 - C. Data prediction
 - D. Data management
5. Data analysis needs to be analyzed in the following aspects (ABD).
 - A. Authenticity
 - B. value
 - C. Technical
 - D. Feasibility
6. There are various types of data collection tables for store operations. The most common one is the daily store operation report, which typically includes the following data indicators (ABCD).
 - A. Traffic
 - B. Order type
 - C. transformation class
 - D. Trading
7. Attention should be paid to the selection of data acquisition tools (ABC).
 - A. Scope of use
 - B. Data type
 - C. Functional requirements
 - D. Technical strength
8. If an independent mall wishes to obtain market development trends for a specific industry segment, it can utilize the following data channels: (ABCD).
 - A. The latest industry analysis report containing the market trend of this industry released by an authoritative data company
 - B. Annual consumption data of key commodities in this industry reported by TV news
 - C. Baidu search index for related keywords
 - D. Market trading index of the industry obtained from business staff

9. Regarding the analysis of competitive products, the following statements are correct (ABD).

- A. Analysis of competitive products can be conducted separately by analyzing basic information on competitive products and evaluating the commodities
- B. Competitive product analysis refers to the analysis of products offered by competitors
- C. Shop detective tools can assist in the competitive product analysis process by enabling the addition of selected competitive products
- D. Analysis of basic information is the foundation of competitive product analysis

10. Regarding the value of market data analysis, the following statements are true (ABCD).

- A. It can aid E-commerce enterprises in identifying operational problems and developing solutions
- B. It is useful for E-commerce enterprises in predicting market conditions
- C. It helps E-commerce enterprises discover and develop potential markets
- D. It improves the scientificity and effectiveness of operational and managerial decisions made by E-commerce enterprises

11. Regarding the market capacity analysis, the following statements are correct (ABD).

- A. Market capacity analysis is helpful in developing sales plans and targets for E-commerce enterprises
- B. The size of the market capacity determines the ceiling of the industry
- C. When conducting market capacity analysis, only the market upper limit of past years can be obtained, and it is not possible to predict the market capacity of future years
- D. Ignoring market capacity and setting sales targets blindly can result in inventory backlog and capital occupation of E-commerce enterprises

12. To calculate the industry Herfindahl index, the key steps include: (ACD).

- A. Obtain the market share of each competitor
- B. Square the market share of each competitor
- C. Calculate the sum of the squared market shares of all competitors
- D. Add the squared market shares of competitors

13. Market demand analysis includes (BCD).

- A. Analysis of industry concentration
- B. Analysis of customer attribute preference
- C. Analysis of customer brand preference
- D. Analysis of demand trend

14. Regarding the significance of warehouse data analysis, the following statements are correct: (ABC).

- A. Warehouse data analysis can help judge whether the inventory structure is complete and whether it meets the market demand
- B. Warehouse data analysis can help judge whether the quantity of products is moderate and whether replenishment is needed
- C. Warehouse data analysis can help determine whether the inventory is at a healthy level and whether there is a risk of economic loss
- D. Warehouse data analysis can help judge whether the supplier is changing, stable, or competitive

15. The factor affecting the unit price of customers include: (ABCD).

- A. Commodity pricing
- B. Promotional offers

- C. Related marketing of products
D. Purchase quantity
16. The form of expression of popular commodities includes: (ABC).
A. High traffic
B. High exposure
C. High turnover rate
D. Gawker unit price
17. Operational data analysis includes: (ACD).
A. Customer data analysis
B. Market data analysis
C. Sales data analysis
D. Supply chain data analysis
18. Indicators to measure the effect of keyword promotion include: (ABCD).
A. Amount of display
B. Click through rate
C. Click conversion rate
D Input-output ratio
19. According to product positioning, the product structure can be divided into image products and (ABCD).
A. Profit products
B. Conventional products
C. Popular products
D. Experience products
20. Factors affecting product gross margin include: (AD).
A. Cost of products sold
B. The search index of the product
C. The trading index of the product
D. Sales revenue of products
21. Product demand analysis is one of the contents of product data analysis, about which the following statements are correct (BCD).
A. Determine the analysis content of typical user characteristics according to the research purpose
B. Collect user preferences for product requirements based on the analysis results of typical user characteristics
C. Put forward suggestions on price range, functional selling points, product innovation and packaging of product development through sorting and analyzing demand preferences
D. Establish lasting user loyalty to the product and brand through continuous product upgrading and iteration
22. The correct description of the following method for determining the normal fluctuation range of data indicators is (ABCD).
A. Year-on-year data, which is compared with the same day and same period of last week
B. Month-on-month data, compared with the average value of the same period of the previous three days
C. The transformation of each link shall be compared with the transformation of each link in the previous N days
D. The hourly growth rate is compared with the hourly growth rate of the previous N days

23. Reports can be considered as a means of service. From the perspective of convenience for users to view and use, different design preferences are required for different target users. The correct statement is (ACD).
- A. To the decision-makers, the results should be presented directly in the simplest way, and the operation should be minimized
 - B. What is shown to decision-makers needs to be shown to middle management
 - C. For the managers, on the one hand, they should report the solutions to the problems. On the other hand, they should assist the managers in arranging work downward and solving specific problems
 - D. For front-line executives, reports should be easy to use and targeted to solve specific problems in actual work
24. The decline in dynamic store score (DSR) will seriously affect the display and transformation of goods, so the store should take preventive measures. The following description is correct (ABC).
- A. The main picture and details page does not exaggerate propaganda, does not make promises that cannot be achieved
 - B. Customer service attitude is essential. Customer service personnel need to have professional knowledge, timely response speed, and a good response attitude
 - C. Make use of small gifts to let customers have unexpected surprises
 - D. The speed of logistics is out of the store's control, and only the logistics company can maintain the logistics
25. The text is the core part of a data analysis report, which must be combined with the analysis ideas. The rationality and authenticity of the views should be ensured by rigorous scientific demonstration. The correct description of the text is (BD).
- A. The main text should include three aspects: analysis of background, purpose and thinking
 - B. The main text displays the data analysis process, and analysis results in the way of pictures and pictures
 - C. The display of the body part needs to be beautiful and can be diversified, with a variety of display styles and rich display types
 - D. The text should be scientific and rigorous in the compilation process, with a clear structure and clear conclusions

Appendix E

Test Blueprint

Table E.1 Test Blueprint in English

Instructional Objective	Test Questions	Cognitive Domain						
		Total	R	U	Ap	A	E	C
<p>Module 1</p> <p>Overview of E-commerce data analysis</p>	<p>1. The following operating index system belonging to product operation is (AD). Remember</p> <p>A. Order turnover rate</p> <p>B. Activity participation rate</p> <p>C. Activity ROI</p> <p>D. Product process transformation</p> <p>2. The data indicators that have a significant impact on sales are (ABC). Understand</p> <p>A. Conversion rate</p> <p>B. Unit price of passenger</p> <p>C. UV</p> <p>D. Return on investment</p> <p>3. The following indicator system belonging to the user operation is (BCD). Understand</p> <p>A. income</p> <p>B. Losing users</p> <p>C. Login user</p> <p>D. Newly registered user</p>	3 (12%)	1	2				
<p>Module 2</p> <p>Data analysis and processing</p>	<p>4. The value of E-commerce data operation includes (ACD). Remember</p> <p>A. Know the user</p> <p>B Stealing secrets</p> <p>C. Data prediction</p> <p>D. Data management</p> <p>5. Data analysis needs to be analyzed in the following aspects (ABD). Understand</p> <p>A. Authenticity</p> <p>B, value</p> <p>C. Technical</p> <p>D. Feasibility</p> <p>6. There are various types of data collection tables for store operations. The most common one is the daily store operation report, which typically includes the following data indicators (ABCD). Apply</p>	6 (24%)	1	1	2	2		

Table E.1 (Continued)

Instructional Objective	Test Questions	Cognitive Domain						
		Total	R	U	Ap	A	E	C
	<p>A. Traffic</p> <p>B. Order type</p> <p>C, transformation class</p> <p>D) Trading</p> <p>7. Attention should be paid to the selection of data acquisition tools (ABC). Apply</p> <p>A. Scope of use</p> <p>B. Data type</p> <p>C. Functional requirements</p> <p>D. Technical strength</p> <p>8. If an independent mall wishes to obtain market development trends for a specific industry segment, it can utilize the following data channels: (ABCD). Analysis</p> <p>A. The latest industry analysis report containing the market trend of this industry released by an authoritative data company</p> <p>B. Annual consumption data of key commodities in this industry reported by TV news</p> <p>C. Baidu search index for related keywords</p> <p>D. Market trading index of the industry obtained from business staff</p> <p>9. Regarding the analysis of competitive products, the following statements are correct (ABD). Analysis</p> <p>A. Analysis of competitive products can be conducted separately by analyzing basic information on competitive products and evaluating the commodities</p> <p>B. Competitive product analysis refers to the analysis of products offered by competitors</p> <p>C. Shop detective tools can assist in the competitive product analysis process by enabling the addition of selected competitive products</p> <p>D. Analysis of basic information is the foundation of competitive</p>							

Table E.1 (Continued)

Instructional Objective	Test Questions	Cognitive Domain						
		Total	R	U	Ap	A	E	C
	product analysis							
Module3 Descriptive analysis of data	10. Regarding the value of market data analysis, the following statements are true (ABCD). Understand A. It can aid E-commerce enterprises in identifying operational problems and developing solutions B. It is useful for E-commerce enterprises in predicting market conditions C. It helps E-commerce enterprises discover and develop potential markets D. It improves the scientificity and effectiveness of operational and managerial decisions made by E-commerce enterprises							
	11. Regarding the market capacity analysis, the following statements are correct (ABD). Understand A. Market capacity analysis is helpful in developing sales plans and targets for E-commerce enterprises B. The size of the market capacity determines the ceiling of the industry C. When conducting market capacity analysis, only the market upper limit of past years can be obtained, and it is not possible to predict the market capacity of future years D. Ignoring market capacity and setting sales targets blindly can result in inventory backlog and capital occupation of E-commerce enterprises	11 (44%)		2	1	2	2	4
	12. To calculate the industry Herfindahl index, the key steps include: (ACD). Apply A. Obtain the market share of each competitor B. Square the market share of each competitor							

Table E.1 (Continued)

Instructional Objective	Test Questions	Cognitive Domain					
		Total	R	U	Ap	A	E
	<p>C. Calculate the sum of the squared market shares of all competitors</p> <p>D. Add the squared market shares of competitors</p> <p>13. Market demand analysis includes (BCD). Analysis</p> <p>A. Analysis of industry concentration</p> <p>B. Analysis of customer attribute preference</p> <p>C. Analysis of customer brand preference</p> <p>D. Analysis of demand trend</p> <p>14. Regarding the significance of warehouse – data – analysis, the following statements are correct: (ABC). Analysis</p> <p>A. Warehouse data analysis can help judge whether the inventory structure is complete and whether it meets the market demand</p> <p>B. Warehouse data analysis can help judge whether the quantity of products is moderate and whether replenishment is needed</p> <p>C. Warehouse data analysis can help determine whether the inventory is at a healthy level and whether there is a risk of economic loss</p> <p>D. Warehouse data analysis can help judge whether the supplier is changing, stable, or competitive</p> <p>15. The factor affecting the unit price of customers include: (ABCD). Evaluate</p> <p>A. Commodity pricing</p> <p>B. Promotional offers</p> <p>C. Related marketing of products</p> <p>D. Purchase quantity</p> <p>16. The form of expression of popular commodities includes: (ABC). Create</p> <p>A. High traffic</p> <p>B. High exposure</p> <p>C. High turnover rate</p> <p>D. Gawker unit price</p>						

Table E.1 (Continued)

Instructional Objective	Test Questions	Cognitive Domain					
		Total	R	U	Ap	A	E
	<p>17. Operational data analysis includes: (ACD). Evaluate</p> <p>A. Customer data analysis</p> <p>B. Market data analysis</p> <p>C. Sales data analysis</p> <p>D. Supply chain data analysis</p> <p>18. Indicators to measure the effect of keyword promotion include: (ABCD). Create</p> <p>A. Amount of display</p> <p>B. Click through rate</p> <p>C. Click conversion rate</p> <p>D Input-output ratio</p> <p>19. According to product positioning, the product structure can be divided into image products and (ABCD). Create</p> <p>A. Profit products</p> <p>B. Conventional products</p> <p>C. Popular products</p> <p>D. Experience products</p> <p>20. Factors affecting product gross margin include: (AD). Create</p> <p>A. Cost of products sold</p> <p>B. The search index of the product</p> <p>C. The trading index of the product</p> <p>D. Sales revenue of products</p>						
<p>Module 4</p> <p>Basic data monitoring and report making</p>	<p>21. Product demand analysis is one of the contents of product data analysis, about which the following statements are correct (BCD). Understand</p> <p>A. Determine the analysis content of typical user characteristics according to the research purpose</p> <p>B. Collect user preferences for product requirements based on the analysis results of typical user characteristics</p> <p>C. Put forward suggestions on price range, functional selling points, product innovation and packaging of product development through sorting and analyzing demand preferences</p> <p>D. Establish lasting user loyalty to the product and brand through</p>	5 (20%)		1	1	1	2

Table E.1 (Continued)

Instructional Objective	Test Questions	Cognitive Domain					
		Total	R	U	Ap	A	E
	<p>continuous product upgrading and iteration</p> <p>22. The correct description of the following method for determining the normal fluctuation range of data indicators is (ABCD). Apply</p> <p>A. Year-on-year data, which is compared with the same day and same period of last week</p> <p>B. Month-on-month data, compared with the average value of the same period of the previous three days</p> <p>C. The transformation of each link shall be compared with the transformation of each link in the previous N days</p> <p>D. The hourly growth rate is compared with the hourly growth rate of the previous N days</p> <p>23. Reports can be considered as a means of service. From the perspective of convenience for users to view and use, different design preferences are required for different target users. The correct statement is (ACD). Analysis</p> <p>A. To the decision-makers, the results should be presented directly in the simplest way, and the operation should be minimized</p> <p>B. What is shown to decision-makers needs to be shown to middle management</p> <p>C. For the managers, on the one hand, they should report the solutions to the problems. On the other hand, they should assist the managers in arranging work downward and solving specific problems</p> <p>D. For front-line executives, reports should be easy to use and targeted to solve specific problems in actual work</p> <p>24. The decline in dynamic store score (DSR) will seriously affect</p>						

Table E.1 (Continued)

Instructional Objective	Test Questions	Cognitive Domain						
		Total	R	U	Ap	A	E	C
	<p>the display and transformation of goods, so the store should take preventive measures. The following description is correct (ABC). Create</p> <p>A. The main picture and details page does not exaggerate propaganda, does not make promises that cannot be achieved</p> <p>B. Customer service attitude is essential. Customer service personnel need to have professional knowledge, timely response speed, and a good response attitude</p> <p>C. Make use of small gifts to let customers have unexpected surprises</p> <p>D. The speed of logistics is out of the store's control, and only the logistics company can maintain the logistics</p> <p>25. The text is the core part of a data analysis report, which must be combined with the analysis ideas. The rationality and authenticity of the views should be ensured by rigorous scientific demonstration. The correct description of the text is (BD). Create</p> <p>A. The main text should include three aspects: analysis of background, purpose and thinking</p> <p>B. The main text displays the data analysis process, and analysis results in the way of pictures and pictures</p> <p>C. The display of the body part needs to be beautiful and can be diversified, with a variety of display styles and rich display types</p> <p>D. The text should be scientific and rigorous in the compilation process, with a clear structure and clear conclusions</p>							
	Total	25(100%)						

Test blueprint (Chinese)

R(Remember),U(Understand),Ap(Apply),A(Analysis),E(Evaluate),C(Create).

Table E.2 Test Blueprint in Chinese

Instructional Objective	Test Questions	Cognitive Domain						
		Total	R	U	Ap	A	E	C
Module 1 电商数据分析概述	1、以下属于产品运营的运营指标体系的是（AD） Remember A、 订单流失率 B、 活动参与率 C、 活动 ROI D、 产品各流程转化 2、影响销售额的数据指标主要有（ABC） Understand A、 转化率 B、 客单价 C、 UV D、 投资回报率 3、以下属于用户运营的指标体系的是（BCD） Understand A、 收入 B、 流失用户 C、 登陆用户 D、 新注册用户	3 (12%)	1	2				
Module 2 数据分析与处理	4、电子商务数据化运营的价值包括（ACD） Remember A、 洞悉用户 B、 窃取机密 C、 数据预测 D、 数据化管理 5、数据分析需求分析需要进行以下（ABD）方面的分析。 Understand A、 真实性 B、 价值性 C、 技术性 D、 可行性 6、店铺运营类数据采集表类型多样，最常见的就是店铺运营日报表，包含的数据指标通常有(ABCD)等。 Apply A、 流量类 B、 订单类 C、 转化类 D、 交易类 7、数据采集工具选择过程中需要注意（ABC） Apply 。 A、 使用范围 B、 数据类型 C、 功能需求 D、 技术实力	6 (24%)	1	1	2	2		

Table E.2 (Continued)

Instructional Objective	Test Questions	Cognitive Domain						
		Total	R	U	Ap	A	E	C
	<p>8、一独立商城想要获取某细分行业市场发展趋势，其可以采用的数据渠道有（ABCD）Analysis</p> <p>A、某权威数据公司最新发布的含有该行业市场趋势的行业分析报告</p> <p>B、电视台新闻报道的该行业所属重点商品年度消费数据</p> <p>C、百度指数相关关键词搜索指数</p> <p>D、生意参谋中该行业的市场交易指数</p> <p>9、关于竞品分析，下列说法正确的是（ABD）Analysis。</p> <p>A、竞品分析可以通过竞品基本信息、商品评价等分别展开</p> <p>B、竞品分析就是对竞争对手的商品进行分析</p> <p>C、借助店侦探工具进行竞品分析可直接添加选定的竞品</p> <p>D、基本信息分析是竞品分析的基础</p>							
Module3 数据描述性 分析	<p>10、关于市场数据分析的价值，下列说法正确的是（ABCD）Understand</p> <p>A、可帮助电商企业发现经营中存在的问题并找出解决的办法</p> <p>B、有利于电商企业预测市场行情</p> <p>C、有助于电商企业发现并开拓潜在市场</p> <p>D、提高电商企业经营管理决策的科学性、有效性</p> <p>11、关于市场容量分析，下列说法正确的是（ABD）Understand</p> <p>A、进行市场容量分析，有利于电商企业制定销售计划与目标</p> <p>B、市场容量的大小决定了行业的天花板</p> <p>C、在进行市场容量分析时，仅可获得过往年份的市场容量数据，无法预测未来几年的市场容量</p> <p>D、无视市场容量，盲目制定销售目标，会导致电商企业积压库存、占用资金</p> <p>12、计算行业赫芬达尔指数，其关键步骤包括（ACD）Apply</p> <p>A、获取竞争对手的市场份额</p> <p>B、将竞争对手的市场份额平方值相乘</p> <p>C、计算市场份额的平方值</p> <p>D、将竞争对手的市场份额平方值相加</p>	11 (44%)		2	1	2	2	4

Table E.2 (Continued)

Instructional Objective	Test Questions	Cognitive Domain					
		Total	R	U	Ap	A	E
	<p>13、市场需求分析包括（BCD）这几项内容。Analysis</p> <p>A、行业集中度分析</p> <p>B、客户属性偏好分析</p> <p>C、客户品牌偏好分析</p> <p>D、需求量变化趋势分析</p> <p>14、对于仓储数据分析的意义，下列说法正确的是（ABC）Analysis</p> <p>A、判断库存产品结构是否完整、是否符合市场需求</p> <p>B、判断产品数量是否适中、是否需要补货</p> <p>C、判断库存是否处于健康水平、是否存在经济损失的风险</p> <p>D、判断供应商是否存在变动、是否稳定和具有竞争力</p> <p>15、影响客单价的因素是（ABCD）Evaluate</p> <p>A、商品定价</p> <p>B、促销优惠</p> <p>C、商品的关联营销</p> <p>D、购买数量</p> <p>16、爆款商品的表现形式是（ABC）Create</p> <p>A、高流量</p> <p>B、高曝光量</p> <p>C、高成交转化率</p> <p>D、高客单价</p> <p>17、运营数据分析包括（ACD）Evaluate</p> <p>A、客户数据分析</p> <p>B、市场数据分析</p> <p>C、销售数据分析</p> <p>D、供应链数据分析</p> <p>18、衡量关键词推广效果的指标包含（ABCD）Create</p> <p>A、展现量</p> <p>B、点击率</p> <p>C、点击转化率</p> <p>D、投入产出比</p> <p>19、根据产品定位，可以将产品结构划分为形象产品和（ABCD）Create</p> <p>A、利润产品</p> <p>B、常规产品</p> <p>C、人气产品</p> <p>D、体验产品</p> <p>20、影响产品毛利率的因素包括（AD）Create</p>						

Table E.2 (Continued)

Instructional Objective	Test Questions	Cognitive Domain						
		Total	R	U	Ap	A	E	C
	A、产品的销售成本 B、产品的搜索指数 C、产品的交易指数 D、产品的销售收入							
Module 4 基础数据监控与报表制作	21、产品需求分析是产品数据分析的内容之一，关于该内容下列说法正确的是（BCD） Understand A、根据研究目的，确定典型用户特征的分析内容 B、根据典型用户特征分析结果，收集用户对产品需求的偏好 C、通过整理分析需求偏好提出产品开发的价格区间、功能卖点、产品创新、包装等建议 D、通过产品的不断升级和迭代，树立用户对产品及品牌持久的黏性 22、以下关于数据指标正常波动范围确定的方法描述正确的是（ABCD） Apply A、同比数据，采用与上周同一天同时段进行对比 B、环比数据，与前三天同一时段的平均值进行对比 C、每个环节的转化，采用与前N天每个环节的转化进行对比 D、每个小时的增幅，采用与前N天每个小时增幅进行对比 23、报表可以认为是一种服务手段，从用户方便查看及使用角度出发，针对不同的目标用户需要有不同的设计偏向，以下说法正确的是（ACD） Analysis A、对决策层人员，要直接把结果以最简单的方式呈现，并且尽量减少操作 B、向决策层人员展示的内容都需向中层管理人员展示 C、对管理人员，一方面要汇报问题的解决方案，一方面要协助管理者向下安排工作，解决具体问题 D、对一线执行人员，要求报表便于使用、有针对性，解决实际工作中出现的具体问题 24、店铺动态评分（DSR）下滑，会严重地影响到商品的展现以及转化，店铺应该做好预防工作。以下描述正确的是（ABC） Create A、主图、详情页不夸大宣传，不做实	5 (20%)		1	1	1		2

Table E.2 (Continued)

Instructional Objective	Test Questions	Cognitive Domain						
		Total	R	U	Ap	A	E	C
	<p>现不了的承诺</p> <p>B、客服态度至关重要，客服人员需要有专业知识、及时的响应速度以及良好的回复态度</p> <p>C、利用小赠品，让客户有意外惊喜</p> <p>D、物流速度是店铺不可控的，只能物流公司来维护物流的问题</p> <p>25、正文是一篇数据分析报告的核心部分，必须与分析思路相结合，要以严谨科学的论证，确保观点的合理性和真实性。以下对正文部分的描述正确的是（BD） Create</p> <p>A、正文部分要包括分析背景、目的及思路三方面</p> <p>B、正文部分以图文并茂的方式将数据分析过程与分析结果进行展示</p> <p>C、正文部分的展示需要美观，可以风格多样，加入多种展示样式、丰富展示的类型</p> <p>D、正文在编写过程中应科学严谨、结构清晰、结论明确</p>							
	Total					25(100%)		

Appendix F

E-commerce data analysis and processing teaching design



GuiZhou Vocational Technology College of Electronics & Information

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Course overview

"E-commerce Data Analysis and Application" is a core course for online shop operation. This course aims to equip students with a systematic and clear understanding of E-commerce data analysis, as well as common tools for data storage, query, analysis, and visualization. Through this course, students will be able to master the content, methods, tools, and processes of analyzing industry data, customer data, product data, sales data, promotion data, and employee performance data; This course plans to equip students with an understanding of the concepts, types, and compositions of E-commerce data analysis reports. Students will be able to write analysis reports that meet the requirements of enterprises, and master the tools, methods, and skills of data acquisition and processing. They will also learn how to monitor operational data, identify abnormal data in a timely manner, create data charts and reports, and apply business data analysis knowledge and skills to E-commerce project operations. Through this course, students will consolidate and deepen the students' operational ability.

Teaching methods:

The design idea of this course breaks away from the traditional subject curriculum model by organizing course content around specific tasks. Learning units are built through completing these tasks, and relevant theoretical knowledge is taught in accordance with the requirements of each task. The course focuses on analyzing typical job roles, including enterprise data analyst, data operation specialist, market analysis specialist, and customer data analysis specialist. By analyzing the content, knowledge, and skill requirements of each stage of post-development, project-based learning is used as the primary teaching method to ensure the achievement of curriculum objectives.

Table F.1 E-commerce data analysis and processing teaching design

Num ber	Chapter name	Class hours		Project name	Teaching content	Training methods	Result presentation	Assessment description	Teach ing proce ss (week ly)
		The ory	Pra ctice						
1	Module 1 Overview of E-comm erce data analysis	4	0	Unit 1 E-comm erce Data and data analysis cognition	1. The implications of E-commerce data 2. Classification of E-commerce data 3. The role of E-commerce data analysis 4. Application of E-commerce data analysis	Preview before class, Theoretical , explanation Group discussion, Key analysis, After-school evaluation.	Item inspection record, Online assignments, attendance records, and evaluation after class	1. Self-evaluati on, mutual evaluation and comments of teachers and students in class. 2. Homework	1

Table F.1 (Continued)

Num ber	Chapter name	Class hours		Project name	Teaching content	Training methods	Result presentation	Assessment description	Teach ing proc ess (week ly)
		The ory	Pra ctice						
				Unit 2: Indicators of E-comm erce data analysis	1. Market data indicator 2. Operational data indicators 3. Product data indicators	Preview before class, Theoretical explanation, Group discussion, Key analysis, After-school evaluation.	Item inspection record, Online assignments, attendance records, evaluation after class	1. Self-evaluati on, mutual evaluation and comments of teachers and students in class. 2. Homework	1
				Unit 3 The process of E-comm erce data analysis	1. Define the data analysis objectives 2. Data collection and processing 3. Analyze and present data 4. Write data analysis reports	Preview before class, Theoretical explanation, Group discussion, Key analysis, After-school evaluation.	Project check record, online homework, attendance record, and after-class evaluation.	1. Self-evaluati on, mutual evaluation and comments of teachers and students in class. 2. Homework	1
				Unit two basic data acquisitio n	1. Understand data acquisition (concept, process and method) 2. Precautions for E-commerce data collection	Preview before class, Theoretical explanation, Group discussion, Key analysis, After-school evaluation.	Project check record, online homework, attendance record, after-class, evaluation	1. Self-evaluati on, mutual evaluation and comments of teachers and students in class. 2. Homework	2
				Unit 2 E-comm erce data acquisitio n channels and tools	1. Main sources of data 2. Data collection tools are commonly used	Preview before class, Theoretical explanation, Group discussion, Key analysis, After-school evaluation.	Project check record, online homework, attendance record, and after-class evaluation.	1. Self-evaluati on, mutual evaluation and comments of teachers, and students in class. 2. Homework	2
2	Module two basic data acquisitio n	6	8	Unit 3 Market Data Acquisiti on	1. Industry data collection 2. Competitive data collection	1. The teacher assigned tasks on doctoral guide platform, and the students completed the tasks according to the requirements of the tasks. 2. According to the real business needs of the enterprise, the teacher assigned the real tasks of the school-enterprise cooperative enterprise shop. 3. After class, students are grouped into groups for practical training on the E-commerce comprehensive training platform.	According to the assignment, students submit the data collection results of i doctoral guide platform and Taobao platform.	1. Classroom self-evaluation, mutual evaluation, teacher comments and enterprise evaluation. 2. Homework	2-3

Table F.1 (Continued)

Num ber	Chapter name	Class hours		Project name	Teaching content	Training methods	Result presentation	Assessment description	Teach ing proc ess (week ly)
		The ory	Pra ctice						
				Unit 4 Operation data collection	1. Customer data collection 2. Promote data collection 3. Sales data collection 4. Supply chain data collection	1. The teacher assigned tasks on i doctoral guide platform, and the students completed the tasks according to the requirements of the tasks. 2. According to the real business needs of the enterprise, the teacher assigned the real tasks of the school-enterprise cooperative enterprise shop. 3. After class, students are grouped for practical training on the E-commerce comprehensive training platform.	According to the assignment, students submit the data collection results of i doctoral guide platform and Taobao platform.	1. Classroom self-evaluation, mutual evaluation, teacher comments and enterprise evaluation. 2. Homework	4
				Unit 5 Product data collection	1. Product industry data collection 2. Product capability data collection	1. The teacher assigned tasks on i doctoral guide platform, and the students completed the tasks according to the requirements of the tasks. 2. According to the real business needs of the enterprise, the teacher assigned the real tasks of the school-enterprise cooperative enterprise shop. 3. After class, students are grouped for practical training on the E-commerce comprehensive training platform.	According to the assignment, students submit the data collection results of i doctoral guide platform and Taobao platform.	1. Classroom self-evaluation, mutual evaluation, teacher comments, and enterprise evaluation. 2. Homework	5-6

Table F.1 (Continued)

Num ber	Chapter name	Class hours		Project name	Teaching content	Training methods	Result presentation	Assessment description	Teach ing proc ess (week ly)
		The ory	Pra ctice						
3	Module three Data classificat ion and processin g	8	10	Module 1 Understa nding of data classificat ion and processin g	1. The role of data classification and processing 2. Principles of data classification and processing 3. Methods of data classification and processing	Preview before class, Theoretical explanation, Group discussion, Key analysis, After-school evaluation.	Project check record, online homework, attendance record, after-class evaluation	1. Classroom self-evaluation, mutual evaluation, teacher comments and enterprise evaluation. 2. Homework	7
				Unit 2 Classified statistics	1. Methods of classified statistics 2. Data classification statistics	1. The teacher assigned tasks on i doctoral guide platform, and the students completed the tasks according to the requirements of the tasks. 2. According to the real business needs of the enterprise, the teacher assigned the real tasks of the school-enterprise cooperative enterprise shop. 3. After class, students are grouped for practical training on the E-commerce comprehensive training platform.	According to the assignment, students submit the data classification and statistical results of i doctoral guide platform.	1. Classroom self-evaluation, mutual evaluation, teacher comments and enterprise evaluation. 2. Homework	8
				Unit 3 Data processin g	1. Data cleaning (methods and steps) 2. Data transformation (type and method) 3. Data sorting (rules and methods)	1. The teacher assigned tasks on i doctoral guide platform, and the students completed the tasks according to the requirements of the tasks. 2. According to the real business needs of the enterprise, the teacher assigned the real tasks of the school-enterprise cooperative enterprise shop. 3. After class, students are grouped for practical training on the E-commerce comprehensive training platform.	According to the assignment, students submit the data processing results of i doctoral guide platform.	1. Classroom self-evaluation, mutual evaluation, teacher comments and enterprise evaluation. 2. Homework	9

Table F.1 (Continued)

Num ber	Chapter name	Class hours		Project name	Teaching content	Training methods	Result presentation	Assessment description	Teach ing proc ess (week ly)
		The ory	Pra ctice						
				Unit 4 Data calculatio n	Data calculatio (type, calculatio method)	1. The teacher assigned tasks on i doctoral guide platform, and the students completed the tasks according to the requirements of the tasks. 2. According to the real business needs of the enterprise, the teacher assigned the real tasks of the school-enterprise cooperative enterprise shop. 3. After class, students are grouped for practical training on the E-commerce comprehensive training platform.	According to the assignment, students submit the data calculatio results of i doctoral guide platform.	1. Classroom self-evaluation, mutual evaluation, teacher comments and enterprise evaluation. 2. Homework	10
				Unit 1 Descripti ve statistical analysis	Recognize descriptive statistics	Preview before class, Theoretical explanation, Group discussion, Key analysis, After-school evaluation.	Project check record, online homework, attendance record, after-class evaluation	1. Self-evaluati on, mutual evaluation and comments of teachers and students in class. 2. Homework	11
4	Module 4 Descripti ve analysis of data	8	10	Unit 2 Trend analysis	1. Cognitive trend analysis (concept, function) 2. Chart trend prediction Method (concept, process and method) 3. Time Series prediction method (concept, process and method)	1. The teacher assigned tasks on i doctoral guide platform, and the students completed the tasks according to the requirements of the tasks. 2. According to the real business needs of the enterprise, the teacher assigned the real tasks of the school-enterprise cooperative enterprise shop. 3. After class, students are grouped for practical training on the E-commerce comprehensive training platform.	According to the assignment, students submit the data analysis results of i doctoral guide platform.	1. Classroom self-evaluation, mutual evaluation, teacher comments, and enterprise evaluation. 2. Homework	12

Table F.1 (Continued)

Num ber	Chapter name	Class hours		Project name	Teaching content	Training methods	Result presentation	Assessment description	Teach ing proce ss (week ly)
		The ory	Pra ctice						
				Unit 3 Comparat ive analysis	<ol style="list-style-type: none"> 1. Understanding comparative analysis (usage scenarios and precautions) 2. Comparative analysis method (year-on-year and quarter-on-quarter) 	<ol style="list-style-type: none"> 1. The teacher assigned tasks on i doctoral guide platform, and the students completed the tasks according to the requirements of the tasks. 2. According to the real business needs of the enterprise, the teacher assigned the real tasks of the school-enterprise cooperative enterprise shop. 3. After class, students are grouped for practical training on the E-commerce comprehensive training platform. 	According to the assignment, students submit the data analysis results of i doctoral guide platform.	<ol style="list-style-type: none"> 1. Classroom self-evaluation, mutual evaluation, teacher comments, and enterprise evaluation. 2. Homework 	13
				Unit 4 Other Analytica l methods	<ol style="list-style-type: none"> 1. Frequency analysis 2. Grouping analysis 3. Structural analysis 4. Average analysis method 5. Cross analysis 6. Funnel plot analysis 	<ol style="list-style-type: none"> 1. The teacher assigned tasks on i doctoral guide platform, and the students completed the tasks according to the requirements of the tasks. 2. According to the real business needs of the enterprise, the teacher assigned the real tasks of the school-enterprise cooperative enterprise shop. 3. Students are grouped for practical training on the E-commerce comprehensive training platform after class. 	According to the assignment, students submit the data analysis results of i doctoral guide platform.	<ol style="list-style-type: none"> 1. Classroom self-evaluation, mutual evaluation, teacher comments, and enterprise evaluation. 2. Homework 	14

Table F.1 (Continued)

Num ber	Chapter name	Class hours		Project name	Teaching content	Training methods	Result presentation	Assessment description	Teach ing proc ess (week ly)
		The ory	Pra ctice						
5	Module 5 Basic data monitoring and report making	6	8	Unit 1 Basic data monitoring	<p>1. Key monitoring indicators of daily E-commerce operation</p> <p>2. Monitoring methods of E-commerce data indicators</p> <p>3. Data anomaly cause analysis and solution</p>	<p>1. The teacher assigned tasks on i doctoral guide platform, and the students completed the tasks according to the requirements of the tasks.</p> <p>2. According to the real business needs of the enterprise, the teacher assigned the real tasks of the school-enterprise cooperative enterprise shop.</p> <p>3. After class, students are grouped for practical training on the E-commerce comprehensive training platform.</p>	<p>According to the assignment, students submit the data analysis results of i doctoral guide platform.</p>	<p>1. Classroom self-evaluation, mutual evaluation, teacher comments, and enterprise evaluation.</p> <p>2. Homework</p>	15
				Unit 2 Basic data report making	<p>1. Made daily data reports</p> <p>2. Preparation of special data reports</p>	<p>1. The teacher assigned tasks on i doctoral guide platform, and the students completed the tasks according to the requirements of the tasks.</p> <p>2. According to the real business needs of the enterprise, the teacher assigned the real tasks of the school-enterprise cooperative enterprise shop.</p> <p>3. After class, students are grouped for practical training on the E-commerce comprehensive training platform.</p>	<p>According to the assignment, students submit the data analysis results of i doctoral guide platform.</p>	<p>1. Classroom self-evaluation, mutual evaluation, teacher comments, and enterprise evaluation.</p> <p>2. Homework</p>	16

Table F.1 (Continued)

Num ber	Chapter name	Class hours		Project name	Teaching content	Training methods	Result presentation	Assessment description	Teach ing proce ss (week ly)
		The ory	Pra ctice						
				Unit 3 Basic data chart-mak ing	<ol style="list-style-type: none"> 1. Common chart types 2. Principles and methods of chart selection 3. Make and beautify common E-commerce data charts 	<ol style="list-style-type: none"> 1. The teacher assigned tasks on i doctoral guide platform, and the students completed the tasks according to the requirements of the tasks. 2. According to the real business needs of the enterprise, the teacher assigned the real tasks of the school-enterprise cooperative enterprise shop. 3. After class, students are grouped for practical training on the E-commerce comprehensive training platform. 	<p>According to the assignment, students submit the data analysis results of i doctoral guide platform.</p>	<ol style="list-style-type: none"> 1. Classroom self-evaluation, mutual evaluation, teacher comments and enterprise evaluation. 2. Homework 	17

Appendix G

Characteristics of the TSCCK model

Table G.1 Characteristics of the TSCCK model

Characteristics
<input type="checkbox"/> Learning activities are student-centred. <input type="checkbox"/> Students study together in a participatory way. <input type="checkbox"/> Learning activities are associated with cloud technology. Students learn by using the cloud. <input type="checkbox"/> The learning activities are based on the cloud and Student Content Knowledge (SK), Student Cognitive Knowledge (SCK) and Student Technology Knowledge (STK) are integrated. <input type="checkbox"/> Improve the teaching quality and efficiency, and make students' learning accessible and more enjoyable.
Grounded theories
<input type="checkbox"/> TSCCK model is based on cognitive load theory.
Process
<input type="checkbox"/> Analyse objectives: Objectives are the results or standards expected by teachers and students through teaching activities. <input type="checkbox"/> Analyse the context: This is the learning environment, but also the students. <input type="checkbox"/> Plan: Learning objectives must be determined first, and then the learning resources students need should be determined according to the learning objectives. <input type="checkbox"/> Prepare: teachers should prepare the relevant teaching resources and ensure that they are placed in appropriate locations and can be accessed without issue. <input type="checkbox"/> Design: When utilizing cloud technology, teachers' instructional design should aim to enhance students' cognitive and learning abilities. <input type="checkbox"/> Facilitate: Teachers will provide scaffolding as needed. However, students are encouraged to discover solutions independently for the majority of the time. <input type="checkbox"/> Evaluate: The assessment in this course is divided into process assessment and summative assessment, with the results being securely stored on the cloud. This allows for easy access to students' learning progress through the cloud platform.
Resources
<input type="checkbox"/> It is essential to prepare learning resources in advance. <input type="checkbox"/> The primary resources for TSCCK activities in this course include vocational education cloud services (specifically, e-commerce data analysis and processing), electronic classrooms, and the vocational education cloud mobile application.
Assessment
<input type="checkbox"/> Students can be assessed through the evaluation system of the vocational education Cloud, such as testing.
Teacher's roles
<input type="checkbox"/> Explain to the students the purpose of using cloud technology under the TSCCK model. <input type="checkbox"/> The teacher's primary role in the TSCCK activity class is to lead. <input type="checkbox"/> Teachers actively promote the TSCCK model learning experience supported by cloud technology. <input type="checkbox"/> Teachers use appropriate instructional design to attract students' interest. <input type="checkbox"/> Teachers associate learning goals with practical life knowledge. <input type="checkbox"/> Teachers provide students with helpful learning resources and help students complete their learning tasks. <input type="checkbox"/> Teachers facilitates independent learning by creating a conducive environment for students to discover and solve problems.
Students' roles
<input type="checkbox"/> Under the teaching approach that integrates teaching and practical application, students are empowered to independently practice and tackle real-world challenges. <input type="checkbox"/> While the teacher may offer guidance and support, students are encouraged to take ownership of problem-solving and actively engage in the learning process.

Appendix H

Learning steps of the TSCCK model

Table H.1 Learning steps of the TSCCK model

Step 1. Stimulate the students' personal prior knowledge	
Objectives	
	Encourage students to reflect on their real-life experiences with E-commerce data analysis and processing, and to relate these experiences to what they have learned in this lesson.
Description	
	<p>The teacher informed the students about the classroom learning objectives, which focus on E-commerce data analysis and processing. This includes various aspects, such as data collection, sorting, analysis, processing, and visualization. To facilitate learning, the relevant videos have been made available on the vocational education classroom cloud. The aim is to enhance students' understanding and appreciation of E-commerce data analysis and processing, and to help them connect this knowledge with real-world E-commerce applications.</p> <p>To reduce students' cognitive load when learning new concepts, the teacher utilized electronic classroom software to provide a simple demonstration. Through this demonstration, students were able to gain an intuitive understanding of basic operations, such as data collection, sorting, analysis, processing, and visualization.</p>
Learning sub-step	Learning activities
<p>1.1 Subject teaching</p> <p>Prior to beginning the lesson, students should understand two key points. Firstly, they should become familiar with the basic operations involved in E-commerce data analysis and processing, including data collection, sorting, analysis, processing, and visualization. Secondly, students should be informed that the course content will focus on the fundamental applications of E-commerce data analysis and processing. The goal of the lesson is to enable students to independently perform the relevant E-commerce data analysis and processing operations through their learning.</p>	<p>Students learn about the teaching topic for this class by watching the instructional video provided through the vocational education cloud.</p>
<p>1.2. Previous knowledge simulation</p> <p>By viewing the instructional video, students are encouraged to contemplate the E-commerce data analysis and processing applications that are commonly encountered, and consider the methods of implementing these operations. They are also prompted to ask themselves if they possess the capability to perform these tasks through participation in this course. The intention is to pique the interest of students and inspire them to engage in the learning process.</p>	<p>Students have the opportunity to engage in group discussions and analyses through the use of videos. Simultaneously, teachers can utilize electronic classroom software to control screens, providing students with a straightforward demonstration and reducing their cognitive load. Additionally, teachers can administer online questionnaires to gauge student comprehension of the presented material..</p>
Teacher's tasks	
	<p>Teachers can assess students' prior knowledge through the preliminary knowledge questionnaire completed online.</p> <p>Building upon the cloud classroom learning in vocational education, the teacher can utilize the electronic classroom to provide a demonstration of the E-commerce data analysis and processing operations. The demonstration will be presented in a simple and easily understood manner.</p> <p>The teacher will monitor students' learning progress both online and offline, and will be available to answer questions at any time.</p>
Students' tasks	

Table H.1 (Continued)

	After completing their studies, students will fill out questionnaires and ask questions to teachers through the vocational education cloud system. They will also have the opportunity to share knowledge with their peers. By carefully watching the teacher's demonstration through the electronic teacher software, students can gain a more intuitive and comprehensive understanding of E-commerce data analysis and processing. This approach will enable students to better appreciate the powerful functions of the E-commerce data analysis and processing course.	
Step 2. Guiding the students to follow the teacher		
Objectives		
	1. Introduce the tasks to be completed 2. Guide students to follow the teacher to complete the practical operation tasks	
Description		
	To begin, students will be introduced to the tasks that they will need to complete in this course. These tasks will be tailored to the specific content of the class, such as data collection, sorting, analysis, processing, and visualization. Students will then be guided to follow the teacher in carrying out practical operations. Then guide the students to follow the teacher to carry out the practical operation. After each step is demonstrated by the teacher, students will be given time to practice the operation themselves. This process will continue until all the necessary operations for the course have been demonstrated.	
	Learning sub-step	Learning activities
	2.1 Task Introduction	
	The student tasks will be designed based on the specific content of the class. Examples of tasks may include creating a poster or designing a student grade table.	In the classroom, the teacher will introduce the tasks of the class to students through the electronic classroom software control screen broadcast. Students are expected to listen attentively and ask questions in a timely manner.
	2.2 Guiding student's actual operation	
	The teacher will use the electronic classroom software control screen to demonstrate each step of the operation to the students. During the demonstration, the teacher will monitor the students' progress and understanding. If students have any questions, the teacher will attempt to answer them to ensure that students have a clear understanding of the topic..	The teacher will demonstrate each practical operation task in class, and students will follow along with the demonstration. Throughout the teaching activity, students are encouraged to ask questions at any time if they encounter difficulties or need clarification on any aspect of the task.
Teacher's tasks		
	During the class, the teacher will demonstrate practical operations related to the assigned tasks. The teacher will closely monitor the students' progress and understanding, and answer any questions that arise.	
Students' tasks		
	Pay close attention to the instructions provided by the instructor and diligently carry out the practical exercises outlined in each workbook.	
Step 3. Deal with the operational tasks		
Objectives		
	Let the students complete the above operation from beginning to end, so that the students really master the operation of the practical operation task in this class.	
Description		
	To encourage student learning initiative and facilitate review of each operation in class, all students will be divided into groups of three. Within the groups, students will complement and promote each other's learning, ensuring that the task is completed from start to finish. During group discussions, if any questions arise about the operation, students are encouraged to ask the teacher for clarification. The teacher will promptly address any questions to ensure that everyone is proficient in the task.	
	Learning sub-step	Learning activities
	3.1 The opportunity	

Table H.1 (Continued)

	The objective of this learning process is to provide students with an opportunity to master the essential knowledge and skills required to successfully complete the operation. (1) Grouping (2) Review, summary, and discussion (3) Practical operation (4) Ask questions and solve puzzles	Let the students form a group, review, summarize, discuss and practice independently, and ensure that each group member has mastered the operation steps.
3.2. Presentation		
	The teacher will request that each group selects a representative to share their learning outcomes with the class. Additionally, groups will be encouraged to discuss with one another and submit their opinions to the cloud.	Each group will select a representative to share their learning outcomes with the rest of the class. Furthermore, the shared learning results will be uploaded to the cloud.
Teacher's tasks		
	The teacher will highlight the key points and potential difficulties to the students. In this role, the teacher will act as a scaffold and provide timely assistance to answer any questions the students may have while also controlling the progress of the class.	
Students' tasks		
	The students will form learning groups, independently review and summarize the knowledge and operation steps covered in the class, practice and master the operation skills, seek guidance from the teacher if necessary, and create a learning conclusion for their respective groups. Each group will select a representative to present their findings on the cloud and publish their learning outcomes on the vocational education cloud.	
Step 4. Instruct the operation tasks		
Objectives		
	This step aims to help students enhance their understanding and mastery of relevant operation steps in their future studies, based on the group report and discussion just conducted. The goal is to achieve a better learning outcome.	
	Learning sub-step	Learning activities
	(1) The group that demonstrated exceptional performance (2) Identify the deficiencies within the underperforming group and suggest strategies for improvement (3) Foster a collaborative learning environment that promotes mutual growth and development among the students	Each group identifies their own areas for improvement after receiving feedback from the teacher. They also learn from the strengths and successes of other groups, as well as from the teacher's guidance. This enables them to refine and improve their group conclusions.
Teacher's tasks		
	The teacher's role is to provide feedback (both positive and constructive), while also helping students identify areas for improvement and suggesting ways to enhance their skill set.	
Students' tasks		
	Recognize their shortcomings, and improve their plan.	
Step 5. Assign operation tasks		
Objectives		
	The final step aims to address any knowledge gaps and ensure that even students who may struggle to keep up are able to fully digest and absorb the material in a timely manner.	
Description		
	Through the aforementioned teaching methods, 90% of the students have successfully learned the material. For the remaining minority who may struggle, individualized guidance will be provided to ensure that they also achieve a complete understanding and meet the 100% standard.	
	Learning sub-step	Learning activities
	Teachers utilize the vocational education cloud to distribute questionnaires and gather a list of students with whom they are not familiar. Based on this list, individualized tutoring sessions are conducted.	After compiling the "did not learn" list, the teacher may offer bonus points as a reward for improving student enthusiasm and promoting an active classroom atmosphere. Students who have

Table H.1 (Continued)

	successfully learned the material can recommend counseling for those who are struggling. If the counseling proves effective in helping the struggling students learn, the recommending students may receive additional bonus points.
Teacher's tasks	
	Administer a questionnaire, compile a tally of students who require additional assistance, and coordinate individualized support sessions for those in need.
Students' tasks	
	Encouraging participation from all students, the teacher may foster an environment where those who have successfully learned the material can assist their struggling peers.



Appendix I

E-commerce data analysis and processing lesson design



GuiZhou Vocational Technology College of Electronics & Information

E-commerce data analysis and processing lesson design

Table I.1 E-commerce data analysis and processing lesson design

Course	E-commerce data analysis and processing		
Learning task	Module I Unit 2 Indicators of E-commerce data analysis	Teaching object	Higher vocational E-commerce
Teaching period	2 credit hours	Teacher	
Learning objective	<p>【 Knowledge objective 】 1. Understand the commonly used market indicators and their meanings. 2. Clarify the types of operational indicators and the relationship between them</p> <p>【 Capability objective 】 1. Demonstrate the ability to combine various business data analysis indicators with real-world situations..</p> <p>【 Quality objective 】 1. Categories that can define specific indicators 2. Able to use indicators to analyze practical problems</p>		
Textbook analysis	<p>This course is founded on the E-commerce Data Analysis 1+X Certificate System series textbook (Basic of E-commerce Data Analysis) published by Higher Education Press and edited by Beijing Boguide Future Information Technology Co., LTD., and published by Higher Education Press. The textbook effectively encompasses both the Professional Skill Level Standard of E-commerce Data Analysis and the professional teaching standard, with a focus on real-life case studies. By incorporating vocational activities into the curriculum, the goal of teaching integration is achieved, leading to the development of digital teaching resources and the successful integration of the "Internet +" approach, which bridges the gap between online and offline teaching methods.</p>		
Learning situation analysis	<p>This course is designed for sophomore students majoring in electronic commerce who have already acquired foundational knowledge in electronic commerce, marketing and statistics.</p>		
Teaching content analysis	<p>E-commerce data analysis involves a series of operations including data collection, sorting, and analysis based on specific indicators. Thus, prior to learning the specific methods of data analysis, it is crucial to define the types of indices for e-commerce data and their corresponding core indicators. With a firm grasp on these indicators, appropriate metrics can be selected for corresponding operations based on the analysis target.</p>		
Key points and difficulties	<p>1. Gain a comprehensive understanding of the key metrics for market and operational performance. 2. Clarify the corresponding relationship between relevant indicators.</p>		
Teaching idea	<p>Building upon the classification of E-commerce data, this course delves deeper into the evaluation and analysis of an E-commerce enterprise's 8.18 promotion activity using various indicators. Teachers guide students to think critically and stimulate their interest in learning through the use of teaching methods such as lectures, comparisons, and examples. The primary objective of this course is to familiarize students with different types of data indicators.</p>		
Teaching preparation	<p>Online teaching resources include cloud-based multimedia courseware and pre-issued teaching points for students to preview in advance.</p>		
Main steps of teaching activities			
Serial number	Teaching activity		
1	Check attendance, preview questions		
2	Case introduction		
3	The new course teaches: 1 market index		
4	The new course teaches 2:operational indicators		
5	Teacher's call		
6	Summay		
Details of teaching activities			
Teaching activity	Teaching process design		
Warm-up before class	<p>Teacher activities:</p> <ol style="list-style-type: none"> The teacher responsible for maintaining attendance records, which should be documented in the attendance page of the class teacher's work manual Preview questions will be included in the "three-stage" pre-class preview assessment score in the teacher's work manual. This allows teachers to identify areas where students may require additional attention and adjust their teaching 	<p>Student Activities:</p> <ol style="list-style-type: none"> Preview in advance by using the cloud and the key points issued by the teacher before class; Get your school supplies. Turn over your notebook to answer the teacher's 	

Table I.1 (Continued)

Course	E-commerce data analysis and processing	
	accordingly.	questions.
Lead-in before class	<p>Teacher activities: Following a brief review of the previous class, we introduce a case study focused on evaluating an E-commerce enterprise's 8.18 promotion activity on Taobao. This exercise is designed to encourage students to think critically about the various aspects of data collection and analysis. We explore the indicators used for this purpose and examine the importance of understanding E-commerce data analysis metrics. This discussion leads us to the core focus of this course.</p>	<p>Student Activities: 1. Watch multimedia courseware and listen to the teacher introduce cases; 2. Engage in brief discussions to reflect on and analyze the presented problems.</p>
New lesson teaching 1	<p>Teacher activities: Combine multimedia courseware to teach the course, write the outline on the blackboard for students to take notes and mark key indicators. Unit 2 Indicators of E-commerce data analysis Market indicators (teaching, comparison, examples) Market indicators primarily serve to describe industry trends and enterprise development within a given industry. These metrics are essential for enterprises to consider when making informed business decisions. 1. Industry sales volume 2. Industry Sales Growth Rate (Key points) 4. Industry sales growth rate 6. Market Growth rate (Key) 7. Sales volume of competitors 8. Price of competitors' customers Teacher's activities: summarize the market indicators, emphasize the important and difficult points, and review the ones that students don't understand.</p>	<p>Student Activities: 1. Listen and take notes 2. Think according to the course progress</p>
New lesson teaching 2	<p>Teacher activities: Have you ever shopped on E-commerce platforms such as Taobao, Jingdong, or Vipshop? Are you currently a member? If so, how did you become a member, and how long is your membership valid? From the enterprise's perspective, what kind of data is generated during the operation of the business? These questions will be used to spark discussion and critical thinking among students. The teacher will then provide a brief summary and transition to the core teaching content. Operational indicators (teaching, listing, comparing and giving examples) 1. Customer indicators Customer data operations serve as a critical foundation for enterprise operations. Customer indicators are primarily used to describe the level of engagement and loyalty among a business's customer base. (1) Number of registered customers (2) Number of active customers (3) ratio of active customers (4) Repeat purchase rate (5) Average number of purchases (6) Customer repurchase rate/customer churn (7) Customer retention rate (emphasis) (8) Consumption frequency (9) Number of collectors (10) number of additional buyers 2. Promotion indicators Whether a promotion activity is successful is usually measured from the promotion effect (income, influence), promotion cost and activity adhesion (usually measured by the number of users' attention, the number of collections, the number of additional purchases, the price of customers, etc.).</p>	<p>Student Activities: 1. Listen, think and take notes 2. Discuss and answer questions according to the setting of teaching links</p>

Table I.1 (Continued)

Course	E-commerce data analysis and processing	
	<p>(1) Number of visitors (key) (2) Page views (key) (3) Average visits (4) length of stay (5) Number of inbound visits (6) Miss rate (key) (7) Number of attention (8) number of displays (key) (9) number of clicks (key) (10) conversion rate (key and difficult points)</p> <p>Registration conversion rate, collection conversion rate, collection conversion rate, order conversion rate, Order conversion rate, customer service conversion rate</p> <p>From the customer service point of view, the main investigation of the following two conversion indicators: (focus) consulting conversion rate, payment conversion rate, transaction conversion rate</p> <p>3. Sales indicators</p> <p>The collection of indicators produced in the sales process of enterprises can reveal the operating status of the sales of enterprises.</p> <p>(1) Sales volume (2) sales volume (3) gross profit on sales (4) sales profit</p> <p>(5) Sales profit rate (difficult point) (6) Return on investment (key point)</p> <p>(7) Order conversion rate (key) (8) order return rate</p> <p>(9) Customer unit price (key) (10) Unit price (key)</p> <p>(11) Joint rate (difficulty) (12) moving pin rate (13) unsalable rate</p> <p>4. Supply chain indicators</p> <p>The collation of indicators generated by enterprises within the procurement, logistics, and warehousing links can provide insight into the current state and potential issues within the supply chain.</p> <p>(1) Purchase amount (2) purchase quantity (3) cash on hand</p> <p>(4) sell-out rate (5) average delivery cost (6) order response time</p> <p>(7) Order fulfilment rate (emphasis) (8) Average delivery time</p>	
Teacher's call	In addition to encouraging students to preview material before class, the teacher should provide ample time for students to take notes during class. Teachers can patrol the classroom, maintain teaching order, check students' notes, and answer questions raised by students.	Student Activities: Complete your notes and ask your teacher if you have any questions.
Summarize	Summarize the knowledge points of this course; A comprehensive evaluation of students is conducted based on the results of pre-class preview, in-class teaching and interaction, as well as their performance in class.	Student Activities: Cooperate with teachers to summarize together; Perfect notes
Homework		
<p>1. During the first quarter of 2019, a product was purchased by 500 customers. Of these customers, 280 made at least two purchases, and 60 made a third purchase. None of the customers made more than three purchases. Given this information, what is the repurchase rate?</p> <p>2. Over the past 7 days, an E-commerce food website has had 5000 visitors. Out of these visitors, 1200 people registered as members, 520 people successfully placed orders, and 480 people completed transactions by making payments. What are the registration conversion rate, order conversion rate and transaction conversion rate of this website respectively?</p> <p>3. During a single visit, a visitor may enter the website multiple times and encounter different scenarios. For instance, during one visit, a visitor may have two inbound visits, one of which resulted in a missed opportunity, while the other resulted in continued page views. In this case, what is the miss rate of the visit?</p> <p>4. An E-commerce enterprise completed 1132 transactions within a month, with a total sales value of 21,036 yuan. The transactions were made by 132 unique customers. What is the average unit price and customer unit price for this enterprise for the month?</p>		
Teaching reflection		
Compared to the traditional retail industry, the most prominent characteristic of E-commerce is the ability to monitor and improve all aspects of the business through data analysis. The cornerstone of data analysis is the utilization of data analysis indices. The course content can be perceived as relatively tedious and requires high levels of attention from students. While simple indicators are easily understood, some require repetition and examples to be fully comprehended by students. Assigning note-taking and homework tasks helps solidify the		

Table I.1 (Continued)

Course	E-commerce data analysis and processing
knowledge and establish a foundation for further learning.	



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Appendix J

IOC form

Table J.1 The IOC form with the E-commerce test

Question list	Expert opinion			Advice
	+1	0	-1	
1. The following operating index system belonging to product operation is ().	+1			PASS
2. Data indicators affecting sales mainly include ()	+1			PASS
3. The following indicator system belonging to the user operation is ().	+1			PASS
4. The value of E-commerce data operation includes ().	+1			PASS
5. Data analysis needs to be analyzed in the following aspects().	+1			PASS
6. There are various types of store operation data collection tables. The most common one is the daily store operation report, which usually contains data indicators such as ().	+1			PASS
7. Attention should be paid to the selection of data acquisition tools().	+1			PASS
8. If an independent mall wants to obtain the market development trend of a segmented industry, it can use the following data channels().	+1			PASS
9. Regarding the analysis of competitive products, the following statement is correct().	+1			PASS
10. Regarding the value of market data analysis, the following statement is true().	+1			PASS
11. Regarding the market capacity analysis, the following statement is correct ().	+1			PASS
12. Calculate the industry Herfindahl index, the key steps of which include ()	+1			PASS
13. Market demand analysis includes ().	+1			PASS
14. Regarding the significance of warehouse data analysis, the following statement is correct().	+1			PASS
15. The factor affecting the unit price of customers is. ()	+1			PASS
16. The form of expression of popular commodities is ().	+1			PASS
17. Operational data analysis including ().	+1			PASS
18. Indicators to measure the effect of keyword promotion include ().	+1			PASS
19. According to product positioning, the product structure can be divided into image products and ().	+1			PASS
20. Factors affecting product gross margin include ().	+1			PASS
21. Product demand analysis is one of the contents of product data analysis, about which the following statement is correct ().	+1			PASS
22. The correct description of the following method for determining the normal fluctuation range of data indicators is ().	+1			PASS
23. Reports can be considered as a means of service. From the perspective of convenience for users to view and use, different design preferences are required for different target users. The correct statement is ().	+1			PASS
24. The decline of store dynamic score (DSR) will seriously affect the display and transformation of goods, so the store should take preventive measures. The following description is correct ().	+1			PASS
25. The text is the core part of a data analysis report, which must be combined with the analysis ideas, and the rationality and authenticity of the views should be ensured by rigorous scientific demonstration. The correct description of the text is ().	+1			PASS

IOC form

Table J.2 The IOC form with the WP scale

Question list	Expert opinion			Advice
	+1	0	-1	
1. Central processing: Mental resources for task selection and execution	+1			PASS
2. Response: Mental resources for responding to the task.	+1			PASS
3. Spatial coding: Mental resources for the spatial activity of your brain during the task	+1			PASS
4. Language coding: Mental resources for speech activity of your brain when you complete a task	+1			PASS
5. Visual reception: Mental resources to obtain information from visual channels to complete a task	+1			PASS
6. Auditory reception: Mental resources to obtain information from auditory channels to complete a task	+1			PASS
7. Operational: Impact of moving your limbs on cognitive load to complete a task	+1			PASS

IOC form

Table J.3 The IOC form with the TSCCK model

Question list	Expert opinion			Advice
	+1	0	-1	
1. Student Technology knowledge (STK) refers to their knowledge of both conventional and emerging technologies that can be integrated into the learning process.	+1			PASS
2. The cloud is very convenient for teacher to use.	+1			PASS
3. Before teaching, the technology provided by the cloud can simplify learning tasks and reduce cognitive load.	+1			PASS
4. For example, students log in to the cloud with their accounts, complete relevant learning tasks according to the instructions of the teacher, and engage in relevant practical exercises.	+1			PASS
5. By utilizing the vocational education cloud with TSCCK model, students can construct the cognitive and content knowledge by completing relevant learning tasks.	+1			PASS
6. The unique goal of the TSCCK model is to enhance students' cognitive load and learning achievement through the application of cloud technology.	+1			PASS
7. Student Cognitive knowledge (SCK) refers to the concept of cognitive load involved in cognitive load theory and how teachers should adopt appropriate instruction design to promote students' learning.	+1			PASS
8. From the perspective of cognitive load theory with the cloud, students are presented with learning tasks to make them feel simple and easy to operate, which can reduce their cognitive load.	+1			PASS
9. The technical support provided by the cloud and appropriate teaching methods, and the new way of learning material presentation, reduce the intrinsic cognitive load and extrinsic cognitive load of students.	+1			PASS
10. To promote the smooth implementation of the fundamentals of fundamentals of E-commerce of teaching activities supported by the cloud, teachers must design the steps of teaching activities reasonably, to not only reduce the cognitive load of students but also stimulate their learning interest.	+1			PASS
11. Student Content knowledge (SK) refers to any subject-related knowledge that a student should learn.	+1			PASS
12. The cloud will record, for example, the completion of each student's automatic homework, check-in status, attendance status, etc. These can be used as usual grades and formative assessments; students' mid-term test scores and final scores can also be automatically displayed on the cloud for summative judgments.	+1			PASS

Question list	Expert opinion			Advice
	+1	0	-1	
13. The instructional steps for the TSCCK model are: Step 1: Stimulate the students' personal prior knowledge Step 2: Guide the students to follow the teacher Step 3: Deal with the operational tasks Step 4: Instruct the operation tasks Step 5: Assign operation tasks These teaching steps enhance students' understanding of the learning material.	+1			PASS
14. In the TSCCK model, the teacher introduces the learning tasks to the students, as well as the precautions for the operation process. Students carefully listen to the teacher's instructions and complete the relevant tasks according to the teacher's requirements. These teaching steps enhance students' understanding of the learning material.	+1			PASS
15. In the TSCCK model, during the learning process, the teacher plays the role of providing scaffolding, to help students at critical moments. Students work in groups and use group learning methods to complete relevant learning tasks. These teaching steps enhance students' understanding of the learning material.	+1			PASS
16. In the TSCCK model, during the learning process, the teacher plays the role of "troubleshooter", who urges students to carry out the correct operation. The students discuss the methods and operation steps of completing the learning tasks in groups. These teaching steps enhance students' understanding of the learning material.	+1			PASS
Total				



Appendix K

Record data form

Table K.1 Record data form

Author Name:
Research Title:
Journal Name:
Topic and Detail Cognitive load:

Table K.2 Record data form about the cognitive load theory

Author Name: John Sweller, Jeroen J. G. van Merriënboer & Fred Paas
Research Title: Cognitive Architecture and Instructional Design: 20 Years Later
Journal Name: Educational Psychology Review
Topic and Detail Cognitive load: <p>1. The second section, following the introduction, presents a brief history of cognitive load theory. It begins by discussing the human cognitive architecture as presented in the 1998 article, followed by a description of the categories of cognitive load followed by the seven cognitive load effects discussed in that article.</p> <p>2. The third section discusses the major developments in cognitive load theory between 1998 and 2018: firstly, the strengthening of its theoretical basis by grounding it in evolutionary psychology; secondly, its extension to the level of course and curriculum design in the four-component instructional design model; thirdly, introducing a series of new cognitive load effects including so-called compound effects; fourthly, introducing new methods for measuring the different categories of cognitive load.</p> <p>3. The 1998 article entitled "Cognitive Architecture and Instructional Design" discussed human cognitive architecture including an outline of cognitive load theory and its general principles. It also provided a description of seven cognitive load effects generated by the theory and issues associated with measuring cognitive load.</p>

AUTHOR BIOGRAPHY

Author: Mrs. Qiong Wu

Degree: Doctor of Philosophy

Date of Birth: 5 December 1980

Place of Birth: GuiZhou Province, China

Work Place: GuiZhou Vocational Technology College of Electronics & Information, China

Education: 2023, Ph.D. in Technology-Enhanced Learning and Innovation, King Mongkut's Institute of Technology Ladkrabang, Bangkok, Thailand

2017, Graduated Master Degree in Public Utilities Management (MPA), GuiZhou University, China

2003, Graduated Bachelor Degree in Tourism management, Southwest Normal University, China

Major: Technology Enhanced Learning and Innovation

Presentations and Publications:

Wu, Q., & Ratanaolarn, T. (2023, February). Development of Students' Technology, Cognitive and Content Knowledge (TSCCK) through a cloud to enhance Vocational students' cognitive load and learning achievement. In 2023 14th International Conference on E-Education, E-Business, E-Management and E-Learning (IC4E 2023). IC4E.

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