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Evaluation of Mathematics Deep Learning Teaching in Network Security Human-computer Interaction Environment

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Abstract: *Deep learning refers to the learning in which students selectively absorb new ideas and knowledge based on their initial understanding, and incorporate them into the initial cognitive framework, so as to combine them with students' own ideas and concepts and integrate new knowledge into the old cognitive system, thereby making judgments and solving problems. However, due to the high technical requirements for teachers in deep learning teaching, and the relatively heavy task of mathematics teaching nowadays, many teachers adopt problem-solving teaching methods that do not support the overall development of students. To solve this problem, this article cited the technical methods of network security human-computer interaction to alleviate the current teaching dilemma. This allowed teachers to teach students deep learning methods while completing heavy mathematical teaching tasks. Therefore, based on the network security human-computer interaction environment, this article conducted research on mathematics deep learning teaching, and accurately recognized the current situation of mathematics deep learning teaching, which provided favorable conditions for teachers to teach more easily and students to develop more comprehensively. This paper showed that the average score of students in mathematics tests using the deep learning method based on network security human-computer interaction environment increased by 8.62% compared to the average score of students in mathematics tests using traditional learning methods. At the same time, mathematics teachers' teaching progress, satisfaction with mathematics teachers, and students' enthusiasm for mathematics learning were also higher. It showed that the deep learning teaching of mathematics in the cybersecure human-computer interaction environment could better serve teachers and students, thereby verifying the feasibility of further improving teaching quality and ensuring the learning effect of students.*

Keywords: *Network Security, Human-computer Interaction, Deep Learning, Teaching Mathematics*

1. Introduction

Deep learning teaching means that teachers should connect their teaching with students' life experiences, as well as their original knowledge and cognitive structure. Unlike shallow learning teaching, deep learning teaching is based on allowing students to understand knowledge. That is to say, this not only requires students to know and understand the knowledge and concepts in books, but also requires students to truly understand the inherent logic and significance of knowledge and concepts, and inspire students' thinking to develop their intelligence. This allows students to deeply absorb the knowledge they have learned and use it flexibly. In other words, deep learning teaching is a developmental learning teaching. Therefore, when teaching mathematics, teachers must guide and encourage students to discover knowledge through deep learning, and provide appropriate guidance and explanation in a timely manner to enable students to systematically master the knowledge learned through creating and discovering theorem laws.

Many experts and researchers have conducted research on the teaching of deep learning. Perrotta Carlo believed that methods such as neural networks were not suitable for education, so a detailed study illustrated the literature of some data scientists on deep learning education [1]. Gervet Theophile considered the history of students' previous interactions with intelligent tutoring systems, and believed that with the emergence of increasingly large-scale datasets, deep learning models used to predict student performance became a competitive alternative to logical regression models [2]. Bose Sutapa believed that self-learning materials often lacked mechanisms to ensure deep learning, but they could help address the learning needs of a large number of students [3]. Shorten Connor explored how deep learning could combat pandemics and provide direction for future research on pandemics. He also studied how deep learning could be applied to accurate diagnosis, protein structure prediction, drug reuse, and epidemiology. Finally, the status quo of deep learning was evaluated, and the key limitations of deep learning in epidemiological applications were summarized [4]. Through a brief introduction to deep learning, Zhou Lei analyzed the potential of deep learning as an advanced data mining tool in food sensory and consumption research, and showed that deep learning was superior to other methods. The achievements of deep learning in classification and regression issues would attract more research forces, and would be applied to the food field in the future [5].

Moen Erick reviewed the intersection between deep learning and cell image analysis, and outlined the mathematical mechanisms and programming frameworks for deep learning related to life sciences [6]. Sejnowski Terrence J believed that deep learning provided a natural way to communicate with digital devices and was the foundation for building artificial general intelligence. The mathematical theory of deep learning illustrated how they work, thus enabling people to assess the strengths and weaknesses of different network architectures and make significant improvements [7]. Lu Lu believed that deep learning achieved significant success in different applications, but its application in solving partial differential formulas only recently emerged. Therefore, he introduced the overview of physical information neural networks using deep learning theory [8]. Ghosh Swarnendu discussed various deep learning techniques for image segmentation from an analytical perspective, and introduced some traditional image segmentation methods by describing the impact of deep learning on the field of image segmentation [9]. The above scholars analyzed and studied deep learning from different perspectives, thus verifying the importance of deep learning. However, the results of these studies took a long time and required high requirements for users during the application process. Therefore, the introduction of cybersecurity human-computer interaction methods was very necessary for the teaching of mathematics deep learning.

In recent years, with the development of artificial intelligence, network security human-computer interaction has made many contributions in various aspects, and many experts and scholars have conducted research on it. Ninness Chris discussed the theory and development of artificial intelligence systems and human-computer interaction. He outlined the origins and forms of artificial intelligence, and discussed many ways in which artificial intelligence might have an impact on various aspects of life [10]. Wang Ting presented an intelligent employment rate prediction model based on a human-computer interaction platform, which focused on building a user-friendly system based on human-computer interaction integration [11]. Roque Antonio believed that robots could interact with humans and described how artificial intelligence could be used to help human operators properly calibrate their trust in the system [12]. Based on the network security human-computer interaction environment, the teaching method of deep mathematics learning had the characteristics of fast and accurate, which could improve the quality of mathematics education and teaching.

This article explained the importance and necessity of studying the teaching of deep mathematics learning, and then introduced the human-computer interaction methods for network security and deep mathematics learning methods. By comparing the differences between traditional mathematics teaching methods and research programs for mathematics deep learning teaching in a cybersecure human-computer interaction environment, it was concluded that the average score of students in mathematics exams under the cybersecure human-computer interaction environment was 8.62% higher than that under traditional learning methods.

2. Evaluation of Network Security Human-computer Interaction Environment

2.1 Evaluation of Interaction Methods

With the increasingly mature development of computer technology and artificial intelligence, great progress has been made in the field of robot research. The intelligence, robustness, reliability, and other performance of robots have been greatly improved, and their application range is also becoming wider and wider. In the context of “machine replacement”, “unmanned factory”, and “industry 4.0”, the research on human-computer interaction environments and intelligent robot operating systems has become one of the hottest topics in the field of intelligent robots in recent years. In a cybersecure human-computer interaction environment, robots can conduct human-computer voice communication for professional and non professional users, and achieve real-time automatic perception, so as to achieve autonomous thinking and interaction based on 3D (three-dimensional) scenes, and achieve automatic action with clear action expectations. Human-computer interaction is a way for humans and

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machines to communicate. In the field of artificial intelligence, human-computer interaction technology and related intelligent robot technology are essential and interesting research content. Existing sensory technologies such as listening, speaking, reading, and writing are widely used in human-computer interaction [13]. With the rapid development of mobile internet and mobile intelligent devices, intelligent interaction is widely used in daily work and life, such as online customer service and financial consultation. Table 1 below shows the three modes of human-computer interaction systems.

Table 1: Types of network security human-computer interaction

Interaction method	Different
Based on program instructions	The controllability of the robot is extremely high, but the operation is cumbersome and the operator needs a considerable degree of learning training to be proficient in controlling it.
Graphical interface based	Reduced learning pressure and memory load for the operator, high control efficiency
Force feedback hand controller	Enhances the sense of presence and interactivity, and is the most basic and commonly used form of human-robot interaction

Software command based interaction: In this type of interaction, the operator usually uses an online command program on the computer to directly control the robot by inputting commands, enabling the robot to complete corresponding operations. This method provides high level control of the robot, but it is too cumbersome and requires extensive training for operators to master the necessary skills. Moreover, it provides relatively few text interactive prompts, thus making it not very intuitive to use. Graphical interface based interaction: The graphical interface replaces dull commands, and vivid icons simplify and accelerate each step of operation, thus greatly reducing the learning curve and memory load of the operator. At the same time, a single operation of the graphical interface includes multiple commands, and control performance and efficiency have been improved. Interaction based on hand controller and force feedback: In this interaction, the remote control system includes a hand controller with force feedback, and the motion of the robot is directly controlled by the hand controller. Each joint of the hand controller corresponds to a robot joint. The hand controller also uses force feedback. Therefore, the force sensed by a robot can be transmitted to the operator, thus greatly enhancing the sense of presence and interactivity when receiving feedback from machine manpower. Direct manual control of a robot is the most basic and widely used method for robot interaction with humans.

Human-computer intelligent interaction means that robots and humans can achieve intelligent communication in some way. Although artificial intelligence technology is still in its infancy and faces many challenges, artificial intelligence is the future direction of education development, which can bring education into a new era and help create a truly student centered education system. Human-computer interaction technology emerged with the invention of robot technology. As an important component of the rapid development of robot technology, great progress has been made.

2.2 Deep Learning Methods in Mathematics

The essence of mathematics is a basic point in mathematics teaching and a basic understanding of the basis of mathematical knowledge. Therefore, in teaching, teachers should strive to understand the essence of mathematical content to help students deepen their understanding of knowledge. The proposal of deep learning is not only a powerful response to the background of the times, but also a serious concern for teaching models. Deep learning refers to a learning method in which students focus on complex learning topics, and actively and seriously participate in the learning process, so as to achieve a profound and critical understanding of relevant knowledge, thereby continuously enriching and improving their initial cognitive structure and developing high-level thinking abilities, thus emphasizing the transfer and application of abilities and solving related problems. Deep learning is not simply about accumulating knowledge. In the context of increasing support for deep learning, it is even more important to strengthen students' ability to apply knowledge in the field of discipline [14]. The core of the deep learning revolution comes from applied and computational mathematics, especially from calculus, approximation theory, optimization, and linear algebra [15]. Deep mathematics learning means that students, under the guidance of teachers, devote themselves wholeheartedly to the learning activities of challenging topics and learning tasks, thus engaging in thinking activities centered on operations and logical reasoning, geometric intuition, data analysis, and problem solving, thereby obtaining basic mathematical knowledge and improving thinking skills, as well as developing basic

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reading and writing skills.

Association and structure refer to both the form of a student's learning style and the learning content associated with that learning style. Association and structure are the result of human cognition and the transformation of students' personal experiences. Students are not blank paper or whiteboard, and they have their own experiences. Therefore, association and structure are intended to illustrate that personal experience and human knowledge are mutually satisfying and transformative rather than antagonistic in deep learning. Activities and experiences are key elements of deep learning, and the mechanism of deep learning is introduced. Activity refers to the active actions of students rather than physical activities or physical activities dominated by others. Experience refers to the internal experience of students. Activities and experiences complement each other. Activities trigger internal experiences, and rational and noble experiences come from meaningful social activities. Essence and change answer the question of how to handle learning content to capture the essence of knowledge and achieve its transfer. In other words, deep learning can capture the key features of content, and understand the internal connections of knowledge, so as to exhibit multiple changes in nature [16].

Migration and application solve the problem of transforming knowledge into students' individual experiences, which means transforming the knowledge learned into students' complex practical abilities. Migration and application are based on the premise that students have global capabilities and innovative awareness, while migration and application are also targeted training of students' global capabilities and innovative awareness. Value and evaluation answer the question of the ultimate purpose and significance of education. That is to say, education is a social activity aimed at improving human beings and making them grow. Value and evaluation are the inherent requirements of all human activities, and education is no exception. Mental education makes the value and evaluation of education conscious and clear. It consciously helps students cultivate correct values and core attributes, and helps them consciously grow, so as to consciously guides them to form wise judgments about the people, events, and activities they encounter.

The instructional design of deep learning mainly involves thoughtful planning of problem situations and learning tasks, creating cognitive conflicts among students, organizing deep learning activities, and paying attention to formative evaluation of students. Through deep learning, students gain basic mathematical knowledge and understand the essence of mathematical content. They cultivate mathematical thinking and positive emotions and attitudes, and gradually become independent, critical, creative, and collaborative students. Deep learning in mathematics means understanding the essence of mathematical knowledge, understanding the internal relationship between knowledge, and understanding mathematics as a whole, rather than memorizing and accumulating mathematical knowledge piecemeal, rote memorization, and repeated indoctrination. Deep mathematics learning refers to experiencing mathematical thinking and methods in the production process of knowledge, thus forming mathematical thinking patterns. Mathematical knowledge and methods are linked to practical problems, thereby solving practical problems rather than simply acquiring mathematical concepts, theorems, and other summary knowledge.

Currently, deep learning has achieved many achievements in search technology, data mining, machine learning, machine translation, natural language processing, multimedia learning, speech, and other fields. Machines can imitate humans through deep learning, such as vision, hearing, and thinking, and can solve a series of complex pattern recognition problems, thus making significant progress in artificial intelligence technology. Deep learning is not a new creation but the distillation and improvement of many excellent teaching practices and theoretical research from the past to the present, and is a response to all shallow and mechanical learning.

2.3 Measurement of Mathematical Deep Learning

The network security human-computer interaction environment can be seen as an energy model, and the energy function is as follows:

$$R\ (a,b)=\sum_{x,y}p_{xy}a_xb_y-\sum_x m_xa_x-\sum_y q_yb_y \tag{1}$$

Cyber security human-computer interaction is used to define joint probability distribution for mathematical deep learning teaching:

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$$h(a,b)=\frac{1}{w}\sum_{a,b} w^{a,b} \tag{2}$$

It is assumed that a is a visible layer, the probability of the x-th hidden layer node $b_y = 1$ in mathematics deep learning teaching is as follows:

$$h(b_y = 1)=\sum^{1} p_x a_y \tag{3}$$

It is assumed that b is a hidden layer, the probability of the y-th visible layer node $a_x = 1$ in mathematics deep learning teaching is as follows:

$$h(a_x = 1)=\sum^{1} p_x b_x \tag{4}$$

The formula for the $d=\{a_1,a_2,\ldots,a_n\}$ mathematics deep learning teaching function is as follows:

$$w(t)=\frac{1}{N}\sum_{x=1}^{N} h_t(a_1)-\sum_{x=1}^{N}\sum_{y=1}^{N} p_{xy} \tag{5}$$

2.4 Teaching Evaluation of Deep Mathematics Learning

With the development of the times, significant changes have taken place in the mathematics teaching concepts, teaching methods, teaching strategies, and evaluation methods of most mathematics teachers. However, many math teachers still have many puzzles in math classroom teaching due to insufficient preparation and poor quality of math teaching design. Therefore, by improving mathematics teaching design, the quality of mathematics teaching has been improved, which has become a widespread concern. During this period, mathematics deep learning teaching emerged as the times require, and mathematics deep learning teaching is an important way to improve the quality of mathematics teaching. In an era of rapid change, there is a need for highly skilled personnel who can learn, apply, and innovate. This also requires students to actively reflect and critically acquire, construct, transfer, and use knowledge to solve problems. The era of knowledge socialization puts forward higher requirements for learning. Deep learning emphasizes the active participation and experience of students, the integration of knowledge based on critical understanding, the overall construction of the meaning of knowledge, the transfer and application of knowledge, the improvement of problem-solving ability, the development of high-level thinking, the cultivation of overall quality, and the development of social practices that can adapt to future changes. Facts have proven that the characteristics of deep learning are well suited to the requirements of the new era of human learning, and the continuous development of this era has also prompted people to focus on deep learning as a whole. Figure 1 shows the process of deep teaching.

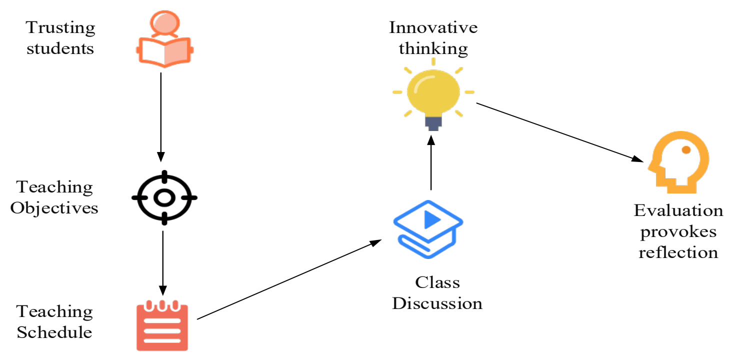

Figure 1: Deep learning teaching process

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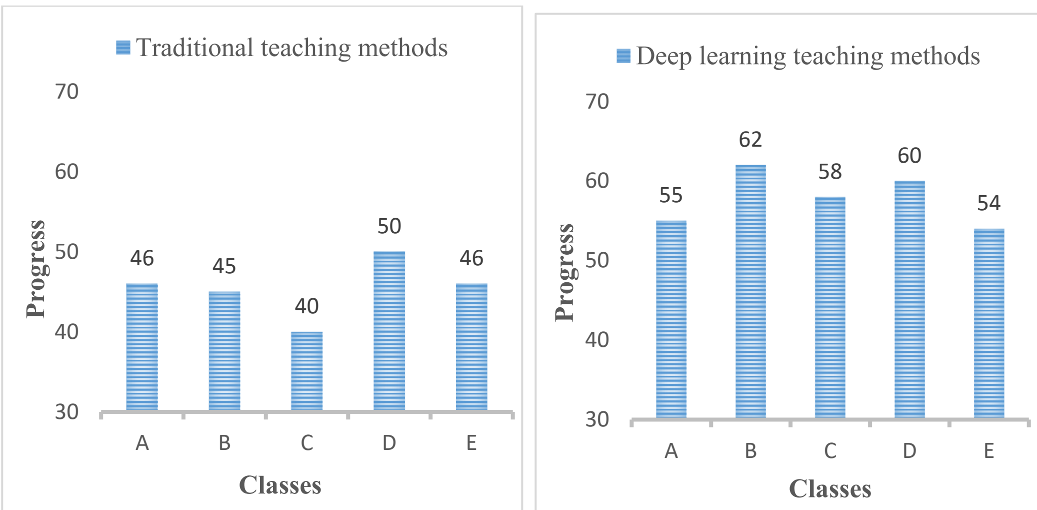
In mathematics learning, students should not only master basic concepts and other related knowledge, but also analyze the essence of mathematics and cultivate their awareness of mathematical application, high-level thinking, and the ability to analyze and solve mathematical problems. The introduction of deep learning is a change in classroom concepts and curriculum design and an important way to cultivate students' core literacy. Teachers can cultivate students' high-level thinking abilities and improve their literacy development level by exploring the essence of knowledge. In this situation, teachers develop mathematical teaching methods from the perspective of deep learning, which can help students learn from shallow to deep levels, and achieve a significant leap from mathematical knowledge to mathematical skills. This is crucial for students to understand mathematical themes, and comprehend thinking methods, so as to accumulate experience in problem solving and effectively develop basic mathematical skills. Especially for students with mathematical learning disabilities, teachers must help students overcome their psychological barriers in learning mathematics and maintain normal learning thinking. At the same time, teachers should encourage students to recognize the importance of mathematical knowledge in the development of modern society and science. They should also encourage students to develop their own learning plans, so that they can develop their own learning and improve their thinking abilities in a coherent manner. In addition, teachers can also encourage students to think more and reflect more during the learning process, and actively communicate with classmates and teachers, so as to learn from each other to improve the quality of learning and achieve the goal of effective learning mathematics.

3. Comparative Experiment on Deep Learning Teaching of Mathematics

In order to verify the advantages of cybersecure human-computer interaction environment in mathematics deep learning teaching, this article selected two methods: traditional teaching methods and cybersecure human-computer interaction environment for mathematics deep learning teaching. Five classes in a middle school were used as samples to compare the teaching progress of mathematics teachers, student math exam average scores, math teacher satisfaction, and student math learning enthusiasm. The experimental data were recorded and analyzed.

3.1 Evaluation of Teaching Progress for Math Teachers

A survey was conducted on the teaching progress of mathematics teachers in five classes (A, B, C, D, and E) of a middle school. Under the traditional learning and teaching methods and the network security human-computer interaction environment, mathematics teachers' teaching progress was counted from the beginning of the semester to the mid-term exam. The details are shown in Figure 2.



a) Based on traditional teaching methods *b) Based on Deep learning teaching methods*

Figure 2: Comparative analysis of mathematics teachers' teaching progress in two groups of images

Figure a showed the teaching progress of mathematics teachers under traditional learning and teaching methods from the beginning of the semester to the midterm exam. Figure b showed the teaching progress of mathematics teachers from the beginning of the semester to the midterm exam under the teaching method of mathematics deep learning in the cybersecure human-computer

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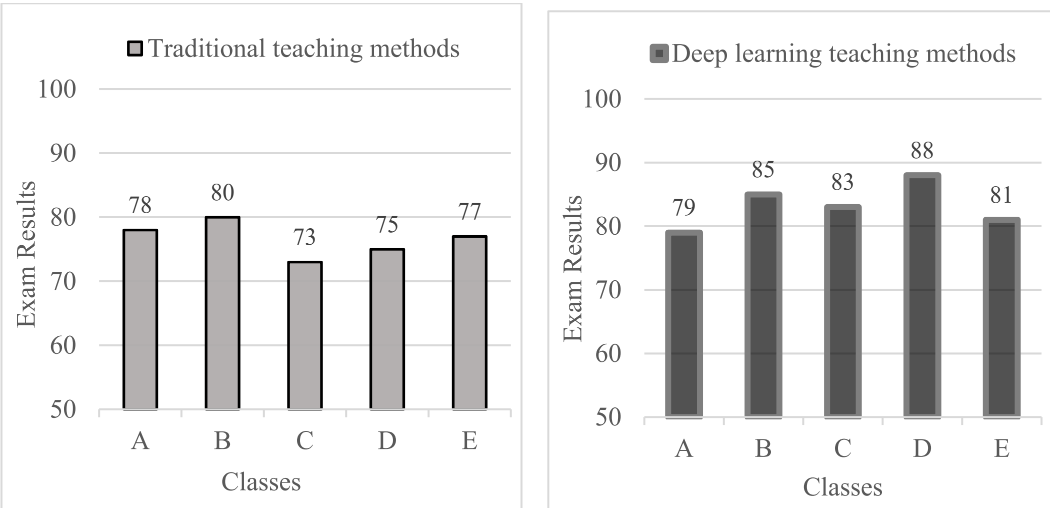
interaction environment. As could be seen from Figure 2, under the traditional learning and teaching method in Figure a, Class D had the fastest teaching progress among the five classes, reaching 50%. Class C had the slowest teaching progress, which was 40%. Under traditional learning and teaching methods, except for Class D, the teaching progress of the other four classes at the end of the midterm examination was not half of the entire semester. Progress and efficiency were low. In Figure b, under the teaching method of mathematics deep learning in the cybersecurity human-computer interaction environment, Class B had the fastest teaching progress among the five classes, reaching 62%. Class E was the slowest but also completed 54%. Under the teaching method of mathematics deep learning in the cybersecure human-computer interaction environment, the teaching progress of the five classes exceeded half, with high efficiency. Therefore, the teaching progress of mathematics teachers under the deep learning teaching method of mathematics in the cybersecure human-computer interaction environment was faster and more efficient than that under the traditional learning teaching method. Therefore, it could be concluded that the deep learning and teaching of mathematics in the cybersecure human-computer interaction environment was faster and more efficient.

3.2 Evaluation of Student Math Exam Average Scores

The average scores of students in five classes (A, B, C, D, and E) of a middle school in mathematics examinations were investigated, and the average scores of students in mathematics mid-term examinations under traditional learning and teaching methods and the network security human-computer interaction environment were calculated, as shown in Figure 3.



a) Based on traditional teaching methods *b) Based on Deep learning teaching methods*

Figure 3: A comparative analysis of the mean scores of students' mathematics examinations in two groups of pictures

Figure a showed the average scores of students in math exams under traditional learning and teaching methods, and Figure b showed the average scores of students in math exams under the network security human-computer interaction environment for math deep learning and teaching methods. As could be seen from Figure 3, in Figure b, under the teaching method of mathematics deep learning in the cybersecurity human-computer interaction environment, students in Class D had the highest average score in the mid-term math exam, reaching 88 points. The students in Class A had the lowest average math midterm exam scores, but they also improved compared to Figure a, reaching 79 points. From Figure 3, it could be calculated that the average score of the students in the five classes in Figure a under the traditional learning and teaching method in the math exam was 76.6 points. In Figure b, the average score of the students in the five classes under the teaching method of mathematics deep learning in the cybersecure human-computer interaction environment was 83.2 points. Therefore, the average score in Figure b was 8.62% higher than the average score in Figure a. Under the teaching method of mathematics deep learning in the cybersecure human-computer interaction environment, students' average math exam scores were higher. Therefore, it could be concluded that compared to traditional learning and teaching methods, students' average scores in mathematics exams were higher in the network security human-computer interaction environment.

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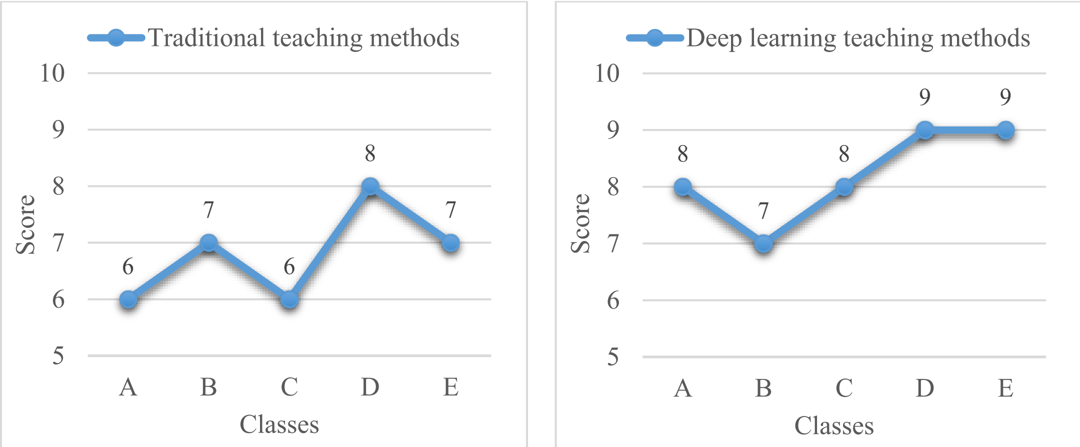
3.3 Evaluation of Mathematics Teacher Satisfaction

A survey was conducted on the satisfaction of mathematics teachers in five classes (A, B, C, D, and E) in a middle school, and the satisfaction of mathematics teachers under the traditional learning and teaching methods and the network security human-computer interaction environment for mathematics deep learning and teaching methods was calculated, as shown in Figure 4.



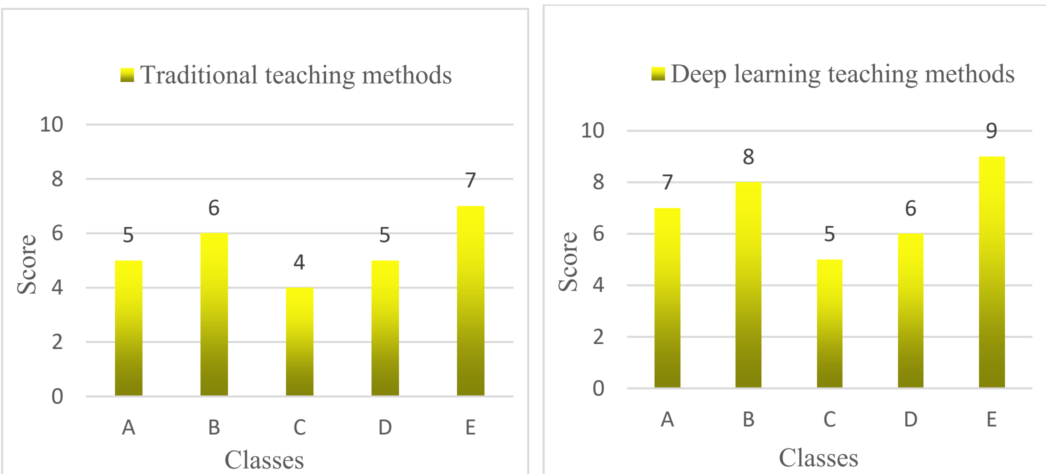
a)Based on traditional teaching methods *b)Based on Deep learning teaching methods*

Figure 4: Comparative analysis of mathematics teachers' satisfaction in two groups of pictures

Figure a showed mathematics teacher satisfaction with traditional learning and teaching methods, and Figure b showed mathematics teacher satisfaction with deep learning and teaching methods in a cybersecure human-computer interaction environment. As could be seen from Figure 4, in Figure a, under the traditional learning and teaching method, the mathematics teacher satisfaction of Class D was the highest, reaching 8 points. Class A and Class C had the lowest satisfaction with mathematics teachers, with a score of 6; in Figure b, under the deep learning teaching method of mathematics in the cybersecure human-computer interaction environment, mathematics teachers in Classes D and E had the highest satisfaction, reaching 9 points. Class B's math teacher satisfaction was the lowest, with a score of 7. Therefore, the mathematics teacher satisfaction in Figure b was higher than that in Figure a.

3.4 Evaluation of Students' Enthusiasm for Mathematics Learning

An investigation was conducted on the students' mathematics learning enthusiasm in five classes (A, B, C, D, and E) of a middle school, and statistics were made on the students' mathematics learning enthusiasm under the traditional learning and teaching methods and the deep learning and teaching methods of mathematics in the network security human-computer interaction environment, as shown in Figure 5.



a) Based on traditional teaching methods *b) Based on Deep learning teaching methods*

Figure 5: Comparative analysis of students' motivation to learn mathematics in two groups of pictures

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Figure a showed students' enthusiasm for mathematics learning under traditional learning and teaching methods, and Figure b showed students' enthusiasm for mathematics learning under the deep learning and teaching method of mathematics in the cybersecure human-computer interaction environment. As could be seen from Figure 5, in Figure a, under the traditional learning and teaching method, the students in Class E scored the highest in mathematics learning motivation, reaching 7 points. The students in Class C scored the lowest in mathematics learning motivation, with a score of 4; in Figure b, under the teaching method of mathematics deep learning in the cybersecure human-computer interaction environment, students in Class E scored the highest level of mathematics learning motivation, reaching 9 points. The students in Class C scored the lowest in math learning motivation. However, compared to Figure a, they also improved, with a score of 5. Therefore, the students in Figure b were more motivated to learn mathematics than the students in Figure a were. Therefore, it could be concluded that compared to traditional learning and teaching methods, students' enthusiasm for mathematics learning was higher in the network security human-computer interaction environment.

Through the research on the teaching methods of deep mathematics learning in the cybersecure human-computer interaction environment, the traditional teaching methods of mathematics, which focused on shallow level learning and problem solving tactics, could be effectively solved, thereby better serving the improvement of teaching quality. Therefore, this article would apply the network security human-computer interaction environment to the research of deep mathematics learning teaching methods, and verify its effectiveness and efficiency, which verified the feasibility of further improving teaching quality and ensuring the learning effect of students.

4. Conclusions

Therefore, it is crucial to continuously improve classroom effectiveness, and continuously improve teaching concepts, so as to actively transform teaching methods, and design mathematical teaching from the perspective of deep learning to achieve mathematical goals. This article first described the importance and necessity of studying mathematical deep learning teaching methods under the network security human-computer interaction environment, as well as related technical methods. It focused on discussing the research and implementation of mathematical deep learning teaching methods based on the network security human-computer interaction environment. Finally, the specific application of the network security human-computer interaction environment in the teaching method of deep mathematics learning was introduced. Through the research and application of the network security human-computer interaction environment, the implementation of mathematical deep learning teaching methods could be promoted, thereby effectively improving teaching quality and ensuring student learning effectiveness.

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