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Video Image Analysis Technology of Digital Media Teaching in View of Cloud Computing

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Abstract In the context of the digital age, various digital technologies have appeared, such as wireless networks and multimedia technologies have been used maturely in teaching. The traditional method is rigid, just teaching blindly, while digital teaching can break through the time and space constraints, teachers & students can interact in real time through wireless networks and multimedia devices, creating a positive learning atmosphere. In recent years, an increasing number of teachers have applied digital media (abbreviated as DM here) technology to teaching activities. On the one hand, DM itself has the advantages of convenient operation and comprehensive functions. On the other hand, it can be used to build a teaching system that conforms to the features of modern education. In the digital media teaching (abbreviated as DMT for short) system, digital video is a regularly used teaching method. Whether teachers or students, they can use computers, tablets, intelligent drawing boards and other multimedia devices to find teaching resources and learn teaching content. With the increase of the number and types of videos, the conventional DMT system has exposed shortcomings such as slow video processing speed, video recommendation errors, etc., which ultimately led to a continuous decline in teaching effectiveness. Cloud computing is an advanced network technology, which can process various data accurately and quickly. At present, this technology is quite mature. Under this background, this text studies the video image analysis in DMT with cloud computing. By analyzing the components of cloud computing system (CCS), this text summarizes its application in DMT, and then gives the implementation process of video image analysis in DMT based on image analysis, and finally adds a video image analysis algorithm based on deep learning (DL). The experimental results show that the teaching efficiency is improved by 9.72% after the implementation of the new image analysis application strategy, and the new video image analysis method also improves the processing efficiency of teaching videos.

Index Terms Image Analysis, Teaching Video, Digital Media Technology, Cloud Computing

I. Introduction

Digital media teaching not only stimulates students' enthusiasm for learning, but also improves the teaching effect of teachers. With the increase of subject content, the types and number of teaching videos are also increasing. This is an urgent need for a video image analysis method based on DMT. After building a DMT platform combining cloud computing, this text applies video image analysis to teaching, aiming to improve the processing efficiency of teaching videos, as well as the teaching effect of DM.

Image analysis is a branch of computer technology, which has been commonly used in teaching. Yaniv Ziv designed an image analysis program that guaranteed the use of computing tools and applied it to the field of education. Research shows that the program performs well in reanalysis of teaching data [1]. Khalid Ziad used image analysis technology to study the problem of gender bias in English video databases, and finally concluded that there is gender bias in the databases [2]. Lopez-Martinez Alan proposed a new optimization algorithm for circle detection based on image analysis. Simulation results show that the algorithm can provide more accurate optimization scheme [3]. Berg Stuart applied image analysis technology to the teaching system based on human-computer interaction, and finally provided teachers & students with more accurate teaching resources [4]. Wiley Victor introduced the latest progress of computer vision and image analysis technology, and expressed his views on how image analysis should be applied to the teaching field [5]. Wang Zhonghua analyzed the specific role of image analysis technology in DMT. Analysis shows that this technology not only innovates teaching methods, but also arouses students' enthusiasm for learning [6]. Niu Feng believed that computer technology offered technical support to the progress of professional courses, and points out that image analysis technology is an indispensable teaching method in environmental art teaching [7]. These research on image analysis in the teaching field had reference value, but did not involve DMT.

In the context of the digital age, there are more and more researches on DMT. Bond Melissa investigated the current application of DM in college classroom teaching. The survey results show that teachers & students can use existing digital technologies to complete teaching tasks and learning tasks [8]. Wu Shaofei introduced DMT methods in vocational colleges. Practice showed that this method can not only enrich teaching forms, but also inspire the improvement and development of more teaching curriculum platforms [9]. Hobbs Renee briefly introduced the connotation of DM technology, analyzed the application advantages of DM in the network teaching resource system in detail, and finally gave the design and implementation method of DMT [10]. Matijevic Milan investigated the use of teaching tools in DMT. He finally concluded that PPT (PowerPoint) courseware is the most used teaching tool [11]. Riehemann Jens investigated the students' views on DMT methods in college classrooms. The results show that most students believe that this teaching method can improve their learning effect [12]. Sarnok Kritsupath analyzed the applicability of DMT to teachers & students. Research shows that after a period of adaptation, the new teaching method can be highly recognized by teachers & students [13]. Friesem Yonty integrated media literacy education into DMT. Practice shows that students can improve their media literacy by setting DM tasks [14]. These researches on DMT are relatively specific, but they have not been applied to image analysis technology.

With the support of science & technology, DMT with network technology and multimedia technology as the core is stepping into colleges & universities. This text first briefly expounds the origin of DMT methods. Then this text summarizes the composition of CCS and its application in DMT platform. Then it gives the realization process of video image analysis in DMT from three aspects: innovating teaching content and teaching methods, paying attention to experimental teaching, and integrating scientific research into teaching. Finally, it proposes a video image analysis algorithm based on DL. The experimental results show that the research work of this text would be a great importance in promoting the next application of image analysis in DMT.

II. Overview of DMT Methods

At this stage, most schools still maintain a teacher centered teaching system, and the teaching method is mainly to impart knowledge through indoctrination. The so-called teaching objectives and teaching plans are pre customized by the department leaders or superior departments. This inherent teaching framework has virtually brought important influence to teachers & students. The emergence of DM technology has broken this structure and provided a certain technical support for the innovation & reform of the teaching framework. As we all know, the amount of information or data generated by teaching activities is very large, which can not be handled by traditional teaching systems at all. Digital media technology has an advanced computing system, which has a good working efficiency in obtaining and processing information. In addition, the multimedia equipment under this technology can provide teachers & students with rich and targeted learning resources. When the resources are available, teachers & students can conduct real-time barrier free communication, which undoubtedly increases the utilization of teaching time and promotes the feelings between teachers & students. In this way, with the constant updating of teaching concepts, the teaching method focusing on DMT has gradually entered the major universities.

III. Composition of CCS and its Application in DMT Platform

(1) Composition of CCS

As shown in Figure 1, CCS consists of five parts: application server, computing cluster, information repository, client and repository.

The application server is the "bridge" between the computing system and the application program, which is responsible for transmitting the information in the program to the computing equipment for future analysis and processing of various data. Computing cluster, as its name implies, is mainly used for computing. It has the ability to calculate a large amount of data, and can integrate the computing information of various parts. The information repository is responsible for storing various information or data in the whole system and ensuring the accuracy and order of information classification. Clients are various intelligent terminal devices, such as computers, tablets, smartphones, etc. These devices are mainly responsible for executing various commands or instructions of users. The resource library is a very large data center, where all kinds of DM are produced and built. After the cloud platform obtains the data to be calculated, it would be transmitted to the resource library through the network server. The data in the resource library would be displayed to users through DM technology after being processed. On the whole, the composition of cloud computer system is not complex, and each component is interrelated and complementary.

(2) Application of Cloud Computing in the Construction of Digital Media Teaching Platform

In the DMT platform, the application of cloud computing technology can greatly improve the overall performance of the platform and make the teaching effect of the platform higher, which is mainly reflected in the teaching resources. It can be summarized as follows:

A. Improve resource utilization

With the constant updating of teaching concepts, the specialized courses in various colleges & universities are becoming more and more diversified and demanding. This text takes the animation production major as an example. The major needs a lot of relevant resources to support it, while traditional teaching methods are limited to books or courseware. This kind of teaching resources is not enough, regardless of quality. As shown in Figure 2, the DMT platform based on cloud computing can obtain the teaching resources of colleges & universities in other countries, and the acquisition method can be in the form of online network collection. In addition, after getting rich teaching resources, it can also transfer the resources of school to other schools, so as to realize resource exchange and resource sharing, which would also broaden the knowledge of teachers & students.

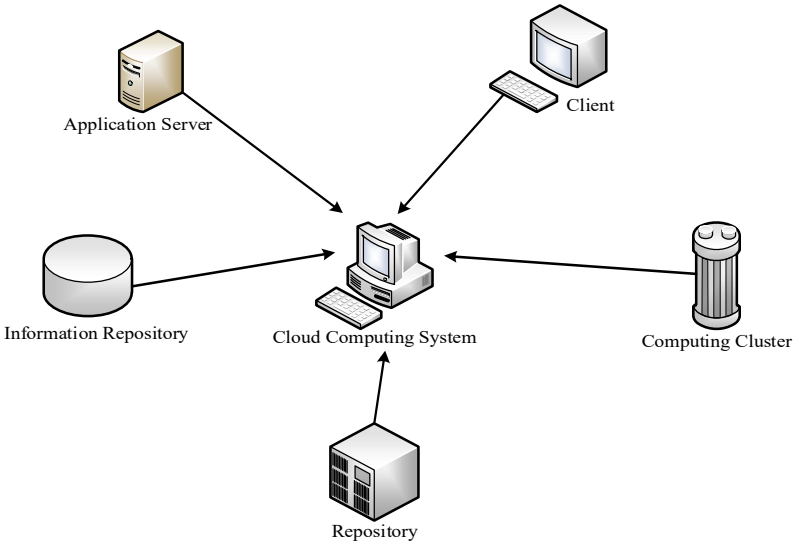

Figure 1: Composition framework of CCS

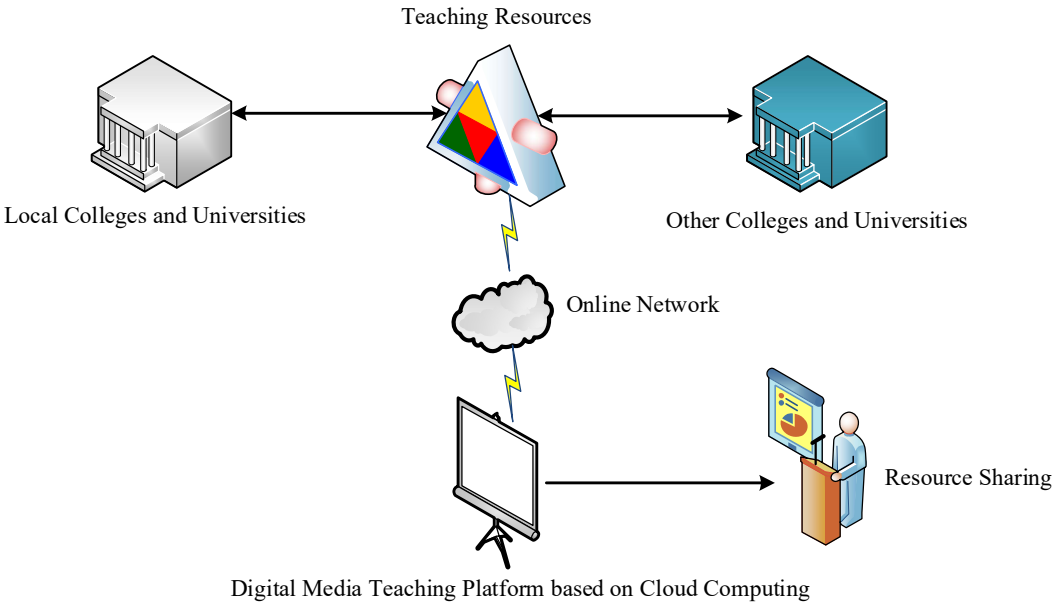

Figure 2: Advantages of DMT platform based on cloud computing

B. Improve resource processing capacity

Conventional DMT platforms are basically content display based. Once courseware production or data calculation occurs, the platform would get stuck or even crash, which would undoubtedly delay the smooth progress of teaching activities. Cloud computing has advanced computing technology, and its computing power is very powerful. After cloud computing technology is applied to the DMT platform, no matter how large the teaching video resources are, it can be processed and classified, and can be timely fed back to teachers & students. After the platform is connected to the wireless network, teachers can obtain teaching resources at any time, and they can show them to students after the analysis and processing of the platform. In addition, students can also use the platform to make learning courseware and classify learning resources.

IV. Implementation Process of Video Image Analysis in DMT

(1) Innovate teaching contents and methods

Image analysis is a complicated subject. Generally speaking, in addition to the core content of the image analysis course, it also includes image data structure, image reconstruction, image classification, image wavelet analysis and image mathematical morphology analysis [15]. Because its content is too complex, it would be a problem for students to grasp all its contents in the limited learning time. In addition, the traditional learning mode only values theoretical knowledge, ignoring the importance of practice. This makes the students' understanding of image analysis not very thorough. Therefore, the course of image analysis must be reformed. In terms of curriculum setting, it can reduce the indoctrination of theoretical knowledge, strengthen the development of practical teaching activities, and enable students to analyze, process and produce video images by themselves using DMT platform. In addition, some application software and image analysis software can be added to the teaching content to let students see the real image change process, which would naturally increase their interest in learning. In this way, students can easily understand the basic principles of image analysis without being bored, which is conducive to stimulating learning enthusiasm.

(2) Pay attention to experimental teaching

The video image analysis is integrated into the experimental course, and relevant image processing algorithms are introduced, including image enhancement, image compression, image separation, image feature extraction, etc. In addition, more detailed algorithms such as image segmentation, image denoising and high-frequency region filtering can also be added.

Before the experimental teaching, students must understand the experimental rules and be familiar with the experimental content in advance, and then conduct preliminary design and analysis of the experiment, write basic code, develop experimental examples, and predict the experimental results. During the experiment, it is necessary to clearly display the image processing results, compare the experimental results with the prediction results, patiently analyze the gap between the two, and prepare an experimental report if necessary to deepen the understanding of digital image analysis technology. Only in this way can students use the knowledge they have learned to solve simple practical problems in the field of image analysis, and finally combine theoretical knowledge with practical applications to enable them to have a more comprehensive grasp of image analysis technology..

(3) Integrate scientific research activities into teaching

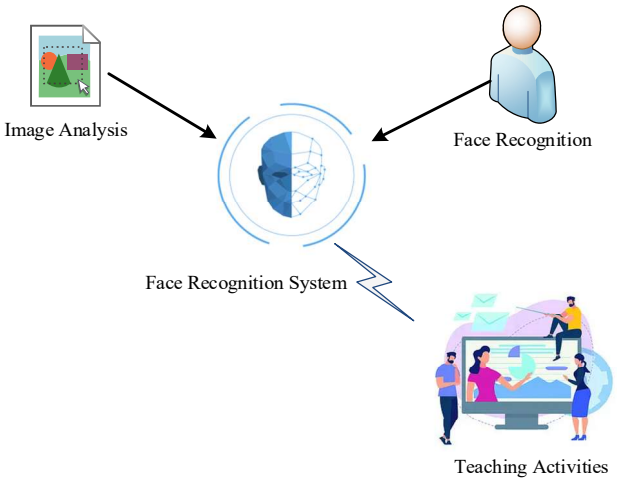

Figure 3: Example of combination of image analysis theory learning and scientific research activities

According to the knowledge level and curriculum content system, theoretical learning and scientific research activities should be combined. As shown in Figure 3, such contents as brain CT image processing, fingerprint recognition and license plate recognition can also be used as teaching contents of video image analysis.

Specifically, the teaching activities can be divided into two parts, one is the theoretical learning part, and the other is the activity development part. In the theoretical learning part, some common application examples can be incorporated, such as video surveillance, medical image segmentation, image noise reduction and moving object detection. Through example explanation, students' enthusiasm for learning can be stimulated and more easily accepted. In this way, students would have a clearer and more thorough grasp of the theoretical knowledge of image analysis. In the activity part, students can be divided into multiple image analysis groups. Under the guidance of the teacher, the group would discuss, analyze the requirements of the activity, define the objectives of the activity, and each group member would assign tasks and determine their own responsibilities and plans. During the activity, the teacher acts as the activity consultant, responsible for answering the questions of each group, and evaluating the learning attitude.

After the completion of the activity, each group shall submit a document of the completion of the activity, show the research results to everyone in the class, and express their views on the completion of the activity, including what they did well or failed to do. Generally speaking, it is an evaluation of self, analyzing advantages and summarizing disadvantages. Finally, this text marks the completion of other groups' activities in groups, and gives the final results of each group after the teacher obtains all the marks.

V. Video Image Analysis Algorithm Based on Deep Learning

In order to make video image analysis more effective in DMT, this text applies Otsu algorithm in deep learning to image analysis. Set the video image to have M gray levels, specifically $0,1,.....M-1$. If the number of pixels of the gray value is X_i, the total number of pixels of the image is $X = X_0 + X_1 + X_2 + \cdots + X_i + \cdots X_{M-1}$. The probability that the gray value is EE can be expressed as:

$$E_i = \frac{X_i}{X} \tag{1}$$

The image is divided into foreground C and background D according to the threshold value, and the variance function can be expressed as:

$$\delta^2(t) = k_1 k_2 (v_1 - v_2)^2 \tag{2}$$

In the formula, t represents the threshold value, k_1 represents the proportion of foreground C in the image, k_2 represents the proportion of background D in the image, $k_1 + k_2 = 1$. v_1 represents the mean value of pixels in the foreground C, and v_2 represents the mean value of pixels in the background D.

Maximize the value of $\left\{\delta^2(t)\right\}$, that is:

$$\delta^2(T) = \max\left\{\delta^2(t)\right\} \tag{3}$$

Then T is the required threshold.

In the process of video image processing, due to the complexity of variance function, equivalent approximate formula can be used to solve it. The specific calculation method is as follows:

$$T = k_1 k_2 (v_1 - v_2)^2 \tag{4}$$

After image preprocessing, it can generally have a detailed understanding of the target areas. The next step is to retrieve these areas by target and create different parameters for each target that represents its attributes. The above algorithm can reduce the noise before processing the image, and adjust the threshold to increase the category distribution, thus making the image background and target area easier to separate.

VI. New DMT Platform and Video Image Analysis Experiment Results

In the context of the digital era, this text studies the DMT platform on account of cloud computing technology, and proposes specific application strategies, finally forming a new DMT platform. Whether the new platform can be recognized by teachers & students, a survey was conducted on 300 teachers & students in an institution, 150

teachers and 150 students each. The content of the survey is satisfaction. The specific results are shown in Table 1.

Table 1: Satisfaction of teachers & students with the new DMT platform

satisfaction	teacher		student	
	number of people	proportion	number of people	proportion
dissatisfied	17	11.3%	21	14%
satisfy	64	42.7%	71	47.3%
Very satisfied	69	46%	58	38.7%

According to the data in Table 1, among 150 teachers, the number of satisfied and very satisfied with the new platform accounts for more than 40% of the total number respectively, which adds up to nearly 90%, while the number of dissatisfied teachers accounts for a very small number. Similarly, more than 80% of the 150 students are satisfied and very satisfied with the new platform, while less than 15% are dissatisfied. These satisfaction conditions can also show that the new DMT platform can be recognized by teachers & students.

The learning enthusiasm of students is the premise to improve the teaching quality and efficiency. In order to further understand the practical effect of the new DMT platform, this text investigates the enthusiasm of students in a college in the application of the new platform, and compares it with the traditional platform. The enthusiasm is set as 100, and the practice time is set as 7 weeks. The specific investigation results are shown in Figure 4.

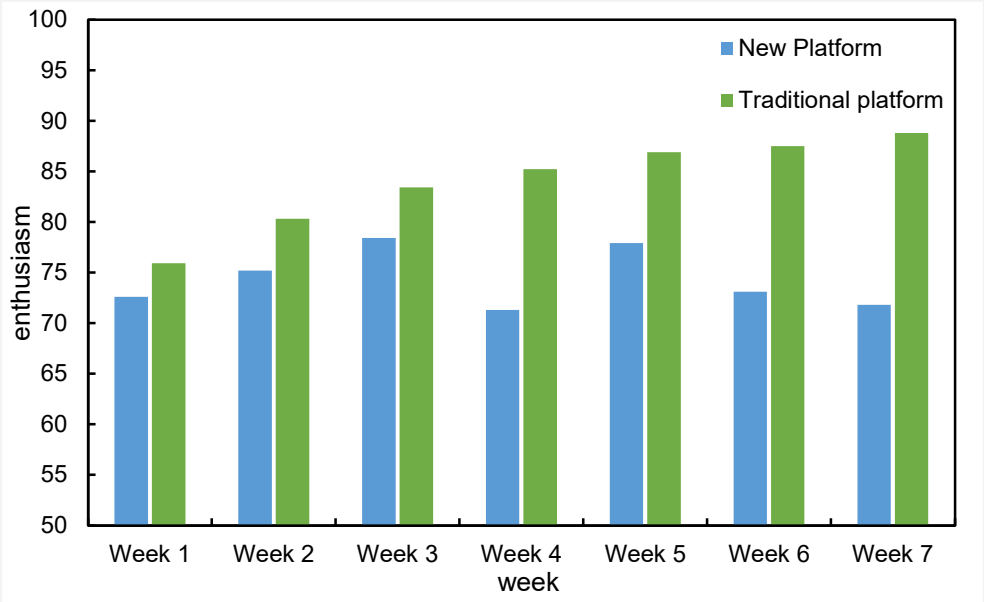

Figure 4: Comparison of enthusiasm between the two platforms

It can be seen from the histogram in Figure 4 that within seven weeks, the enthusiasm under the new platform remained between 71-79, and the weekly enthusiasm gap was relatively large. On the whole, it seems to fluctuate greatly. In contrast, the enthusiasm under the traditional platform remained between 75-89 within 7 weeks, and continued to rise from the first week to the seventh week. In contrast, the enthusiasm under the new platform is much higher than that under the traditional platform. This also shows that the new DMT platform has a good effect in improving students' learning enthusiasm.

In the algorithm part of the article, in order to improve the ability of video image analysis to process video in DMT and improve the processing efficiency, this text proposes an intelligent video image analysis algorithm based on DL. Whether the new algorithm can improve the processing efficiency, the number of videos processed by the DMT platform within 5 hours was tested under the application of the new algorithm, and compared with the number under the conventional algorithm. The test results are shown in Figure 5.

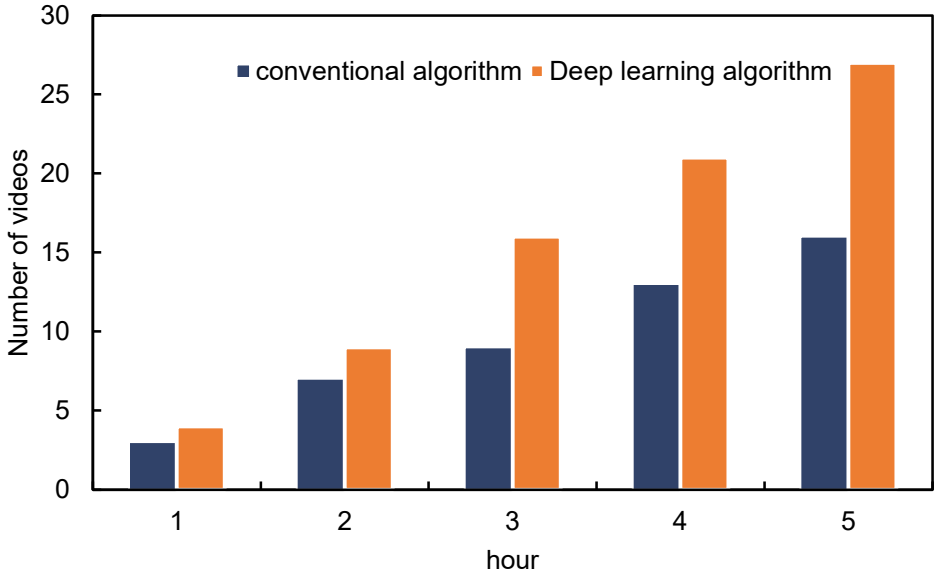

Figure 5: Number of videos processed by DMT platform under two algorithms

It can be seen from the histogram in Figure 5 that the number of video processing under the two algorithms has been increasing with time. Within one hour, the number of video processing of both algorithms is less than 5. After three hours, the number of video processing under the DL algorithm is more than 15, while the number of video processing under the conventional algorithm is less than 10. After five hours, the number of video processing under the conventional algorithm has exceeded 15, while the number of video processing under the DL algorithm has exceeded 25. In contrast, the DL algorithm has more than 10 more than the conventional algorithm. It is obvious that no matter one hour or more, the number of video processing under the DL algorithm is more than that of the conventional algorithm, which also shows that the DL algorithm has a good effect in improving the video processing efficiency.

In the DMT platform, in addition to processing a large number of teaching videos, there are also categories of videos. Only in this way can it ensure that the platform presents targeted teaching video resources to teachers & students. Figure 6 shows the video classification accuracy under the conventional algorithm and the deep learning algorithm. The accuracy is the classification accuracy under different numbers of videos.

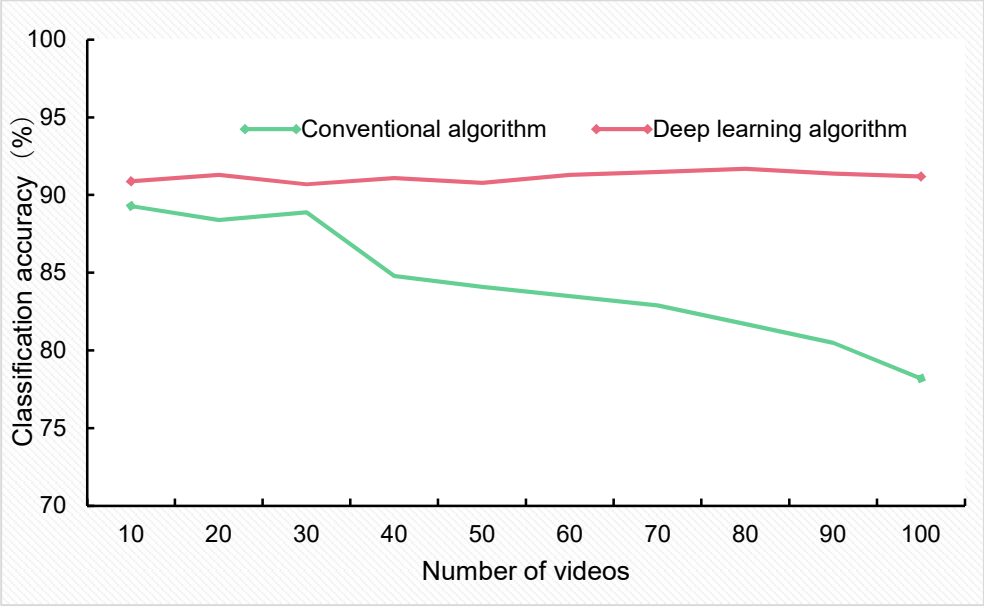

Figure 6: Video classification accuracy under conventional algorithm and deep learning algorithm

From the line graph in Figure 6, it can see that the classification accuracy of conventional algorithms is relatively high in 30 videos, ranging from 88% to 90%. After more than 30 videos, the classification accuracy declined rapidly, and it continued to decline until 100 videos. In contrast, the video classification accuracy of the deep learning algorithm is 90% - 92% from 10 to 100 videos, which can be said to be very stable.

It is very necessary to apply video image analysis technology in DMT. This text gives a new application strategy of image analysis based on cloud computing DMT platform. Under the application of the strategy, the author investigated the changes in the teaching efficiency of 12 weeks (for the convenience of description, the highest teaching efficiency is set at 100%), and compared it with that before the application. The investigation results are shown in Figure 7.

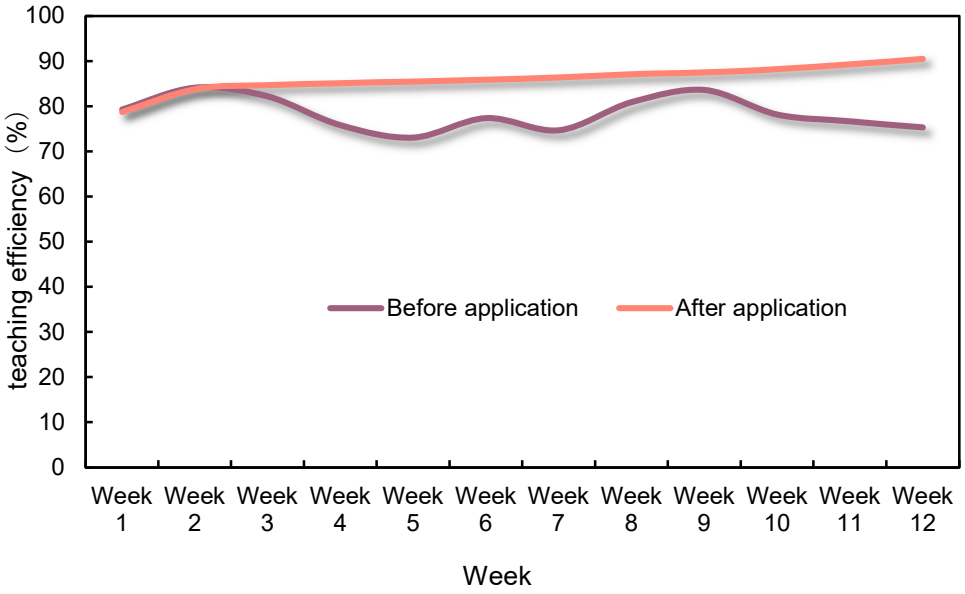

Figure 7: Changes of teaching efficiency before and after application in 12 weeks

It can be seen from the graph in Figure 7 that the teaching efficiency before and after the application is relatively close in the first two weeks, and even slightly lower after the application, because the implementation of this strategy is still in the adaptation period. From the third week, the teaching efficiency after application has been rising steadily. In the 12th week, the teaching efficiency reached the highest level, exceeding 90%. In contrast, the teaching efficiency before application has been fluctuating since the third week, and is lower than that after application. In contrast, within 12 weeks, the teaching efficiency under the application of this strategy was 9.72% higher than before.

VII. Conclusion

The progress of science & technology has promoted the society to move towards the digital era. Under this background, various digital technologies have been gradually applied to education, and DMT is the product of this background. In recent years, a variety of DMT platforms have emerged in many colleges & universities, but with the enhancement of the nature of the discipline, these platforms gradually exposed many shortcomings, especially in video processing. Image analysis is a technology to process graphics and videos through various computer means and algorithms. Applying video image analysis to DMT is bound to promote the smooth development of this teaching method.

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