

Induction of Full-Process Operation System of Teaching Video and Study on Elementary Process

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Abstract. This paper focuses on the full-process operation system and elementary process of teaching videos. The induction and discussion of the full-process operation system constitute a guiding frame for teaching video production to facilitate macro analysis. The elementary process controls and investigates the detailed aspects of production.

Background

Teaching video production refers to the approach of using videos or animations that include image, graphic, text, and audio, to deliver certain useful information and knowledge to students mainly via visual and auditory perception. The Internet boosts the ongoing development and improvement of teaching videos, which have become increasingly important in nowadays education^[1].

Today, there have been thousands of teaching video websites at various scales around the world. In China, for online education alone, the compound annual growth rates averaged 33.1% from 2010 to 2015. The annual growth rate of users of online learning in China reached about 50% in 2015 and was still not slowing down in 2016 and 2017. Teaching videos are involved in almost every conventional and remote classrooms across the globe. With the progress of information technology, the role of teaching video has been more and more prominent in facilitating education. The fact that teaching videos improve the quality and effectiveness of education has been accepted by the majority of both teachers and students.

Although a large number of teaching videos are produced for each discipline each year worldwide, understanding and application of the teaching videos remain in a crude initial stage, and most teaching videos are merely a complete, authentic documentation of the teaching in class. In fact, such practice does not make the most use of teaching videos in assisting education, but simply extend the classes over space and time. The producers and users of teaching videos would be no stranger to similar problems, only to find themselves lacking a comprehensive and reasonable theoretical system that provides guidance. So far, therefore, the production level of teaching video has been slow to change, and various opinions are greatly diversified without a fair and scientific way of guidance.

How to produce and use teaching videos to maximize their function of assisting education? How to make rules for future production and usage of teaching videos to follow? These questions have long been in the area of education science and have not been solved by the production agencies of teaching videos. To thoroughly overcome the difficulty that there are no rules or principles in the production and use of teaching videos, this study is intended to analyze and explore the teaching videos through the theories of educational techniques, transmission, video elements, and pedagogical content knowledge (PCK). Moreover, a structural model of teaching video production with guiding function is established according to the disciplinary logic of education science, in an attempt to analyze, deconstruct, and compare the existing teaching videos. The proposed model provides theoretical guidance for the production and use of teaching videos, which is of great theoretical and practical significance for the majority of teachers and students.

First of all, researches on teaching video are divided into two levels. The first level, known as the microscopic research, is to study the composition of the teaching videos. The second level, known as the macroscopic research, is to study the design, production, use, distribution, evaluation, reflection, and other operation processes related to teaching videos.

Modeling of Full-Process Operation System of Teaching Video

The applied theories of systemic dynamics are necessary to model the system. As a causal mechanism model, the systemic dynamics model emphasizes that the system behavior is mainly determined by the internal mechanism and is effective in dealing with long-term and periodic issues. System dynamics modeling can be divided into the following steps: (1) To understand and define the problem, and then identify the target; (2) to plot the casual feedback diagram of the system; (3) to establish the systemic dynamics model; (4) to test and verify whether the model can reproduce the behaviors of the actual system; (5) to apply the model for the selection of strategies; and (6) to execute the strategies^[2]. The logical framework is constructed as shown in the figure

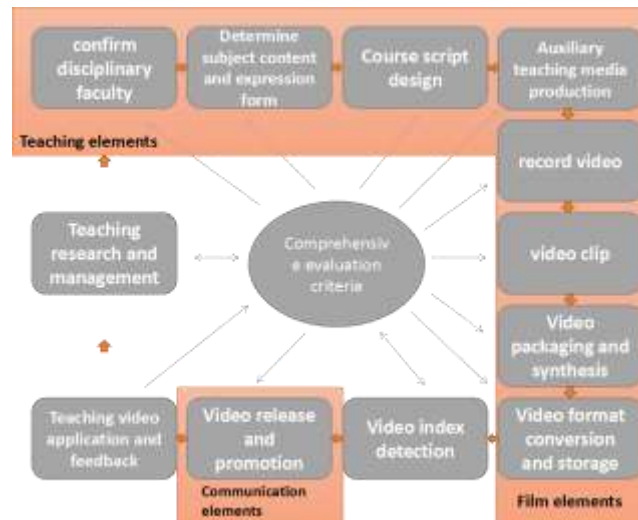


Figure 1. Top view of the logical framework for the full-process operation system of teaching video.

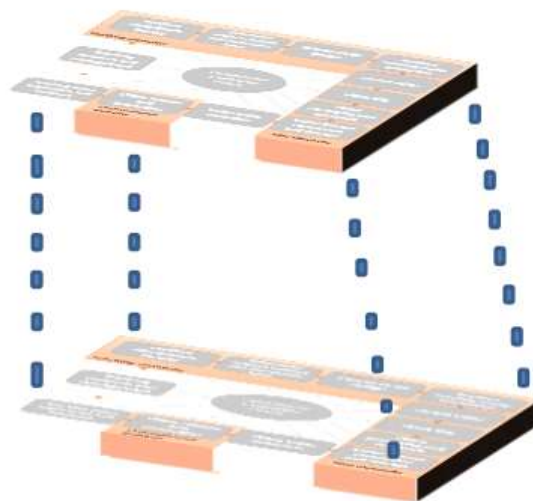


Figure 2. Three-dimensional diagram of the logical framework for the full-process operation system of teaching video.

Comprehensive Description of Full-Process Operation System of Teaching Video Model

The quality and level of the teaching design, shooting skills, and post-production of teaching videos in class directly affect the effectiveness and efficiency of these videos. Therefore, it is essential to properly plan and organize the production of teaching video in class. The film production and transmission in accordance with certain teaching patterns will definitely play some roles in the informational development of education, as well as in the reform of teaching methods^[3]. According to the practical production rules of teaching videos, the proposed system model consists of twelve separate parts. In terms of category attributes, “identifying teaching video subject” and “selecting

environment” belong to the attributes of education; “designing curriculum” belongs to the cross attributes of education, video science, and transmission; “recording teaching videos”, “editing teaching videos”, “packaging and composing teaching videos”, and “storing teaching videos” belong to the attributes of video; “producing supplementary teaching videos” belongs to the cross attributes of education and video elements; “transmitting teaching videos” belongs to the attributes of transmission; and the remaining four parts belong to the attributes related to evaluation.

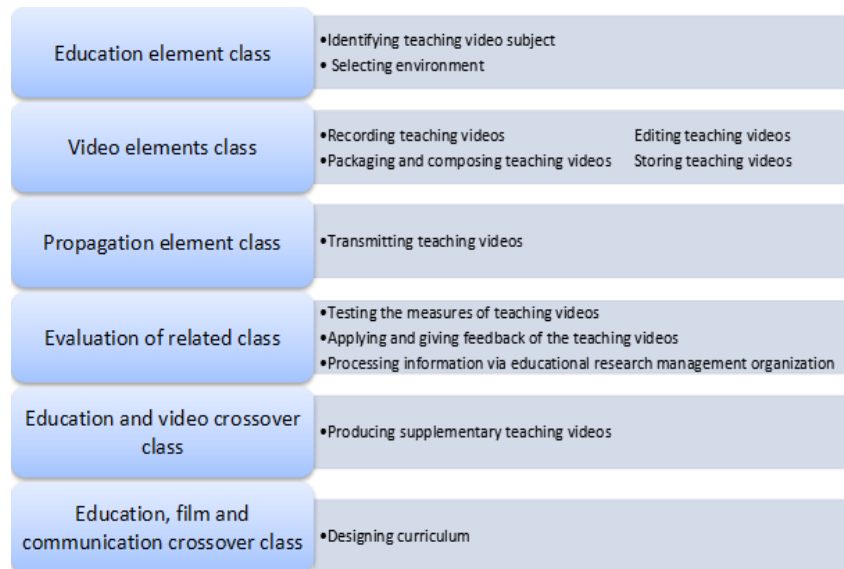


Figure 3. Categories of teaching video full-process system model.

The actual operation processes can be divided into four periods: the preparation period, the production period, the application period, and the evaluation period. Specifically, the preparation period includes (1) identifying the teaching video subject, (2) designing the curriculum, and (3) selecting the environment. The production period includes (1) producing the supplementary teaching media, (2) recording the teaching videos, (3) editing the teaching videos, (4) composing the teaching videos, and (5) storing the teaching videos. The application period includes (1) transmitting the teaching videos and (2) applying and giving feedback of the teaching videos. The evaluation period includes (1) testing the measures of teaching videos and (2) processing information via educational research management organization.

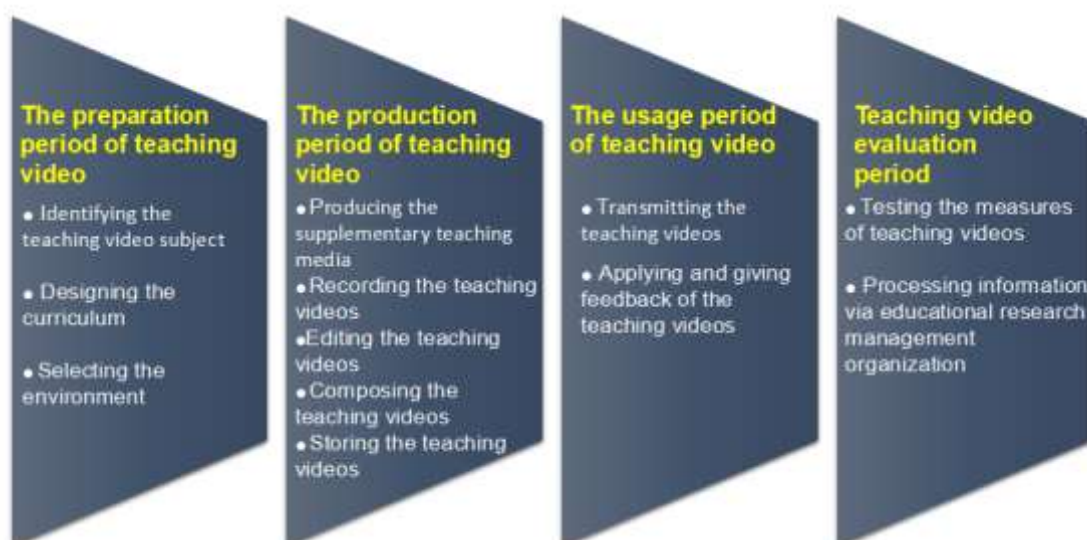


Figure 4. Operation processes of teaching video production.

The preparation period:

According to the teaching video element method, it can be concluded that the technical period of preparation consists of three sub-elements: (1) identifying teaching video subject, (2) designing curriculum, and (3) selecting environment.

Identifying Teaching Video Subject

Here, the teaching video subject refers the major factors that outline a teaching video, including the specific academic knowledge, designated teacher, video duration, and technical requirements.

Designing Curriculum

Designing course element is the most vital part of the entire production of teaching videos. It is arguably the guideline or foundation of teaching videos, and its quality directly determines the teaching outcome of future teaching videos. The criteria of designing course should concentrate on the dimensions of audience, content, application, and technology. Among them, the dimension of audience refers to (1) the cultural attributes (gender, race, nationality, socioeconomic status, etc.) and (2) the individual attributes of the audience. The dimension of content refers to (1) the basic attributes of micro-course content, (2) the relationship of teaching video content, (3) the purpose of teaching video content, and (4) the hierarchy of teaching video. The dimension of application refers to (1) the timing of application, (2) the generation of application, and (3) learning supporting services. The dimension of technology refers to the education, video, and transmission technologies related to the production of teaching videos.^[60] According to teaching theories and production practices, the course design of teaching videos can be roughly divided into (1) determining the course content and teaching plan, (2) determining the teaching methods, (3) designing the teaching programs of knowledge, (4) designing interaction and test programs, (5) designing and selecting auxiliary teaching equipment, (6) selecting environment for course production, (7) specifying technical requirements, (8) converting teaching plans from video to text, (9) selecting teaching media, and (10) designing education transmission programs.

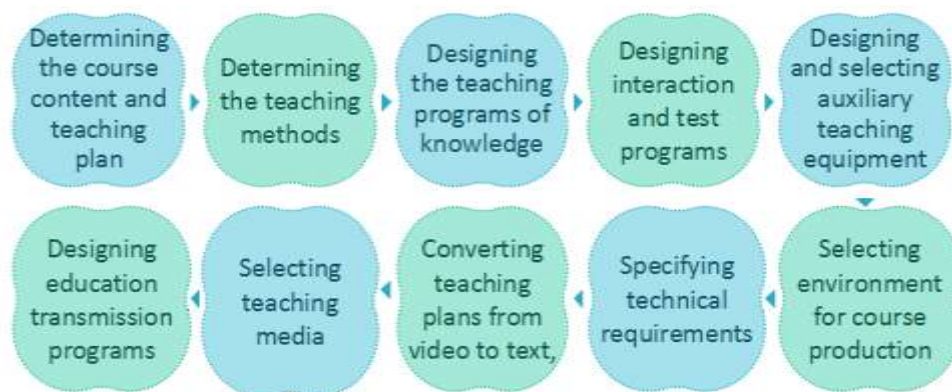


Figure 5. Processes of course design of teaching videos.

Selecting Environment

As suggested by previous researches, the selection principle of teaching environment is mainly based on the following aspects: duration and period of teaching in class, size and location of classroom, and number and quality of participants in class. The specific selection principles and methods will be elaborated in subsequent sections.

Through analysis of the three sub-elements of the preparation period, i.e., identifying the teaching video subject, designing course, and selecting environment, all of them are closely linked to the structure of teaching video. The production period:

According to the teaching video element method, it can be concluded that the technical period of production consists five sub-elements: (1) producing supplementary teaching media element, (2) recording teaching video element, (3) editing teaching video element, (4) composing teaching video element, and (5) storing teaching video element.

Producing Supplementary Teaching Media

The production of supplementary teaching media is a preparation session before shooting the teaching videos.

As a common teaching tool, multimedia courseware is widely used by teachers. Currently, the commonly used multimedia production courseware includes PowerPoint, Prezi, Keynote, Authorware, Director, and FLASH. The production and application of multimedia courseware should follow certain principles. Keeping students proactive and interested in learning new knowledge is a key topic of the design and application of teaching courseware in class, as well as the primary goal of the design and application of teaching courseware. Supplementary teaching videos are the ones processed or directly adopted by teachers to help students better understand, while gaining more interest, image, and visibility.

Recording Teaching Video

A complete set of equipment required for recording teaching videos includes (1) video equipment, (2) audio equipment, (3) lighting equipment, (4) directing equipment, (5) cueing equipment, (6) timing equipment, (7) digital media equipment, (8) virtual reality equipment, (9) auxiliary shooting equipment, and (10) transmission equipment.



Figure 6. Basic shooting system of teaching video.

In general, the basic procedures of recording teaching video are (1) selecting video equipment, (2) tuning video equipment, (3) modeling the teacher, (4) pre-recording, (5) recording, (6) playing back, (7) extra recording, and (8) archiving video and audio copies.

In another approach without the teacher showing up, only the teachers voice is used to teach in the absence of a tangible space. The teaching videos for micro course, flipped classroom, and a few skills are often presented in this way. Its recording procedures are: (1) selecting the video form, (2) producing accordingly, (3) recording via software, (4) playing back, (5) extra recording, and (6) archiving video and audio copies.

Editing Teaching Video

There are actually two types of editing discussed in this paper, that is, the video one and the audio one. The non-linear editing of teaching video usually adopts the processes from general video editing, while featuring its own characteristics. The procedures are roughly as follows: (1) Selecting the video and audio materials according to the scripts of the designed course, (2) editing the materials for the first time, (3) group watching by teachers, (4) editing for the second time based on the teachers' opinions, (5) adding special effects, (6) group watching by teachers and students, (7) editing for the third time based on summarized opinions, and (8) generating a teaching video in full structure for the

next step. The non-linear editing system of teaching video is basically equivalent to that of professional video making, as shown in the figure.

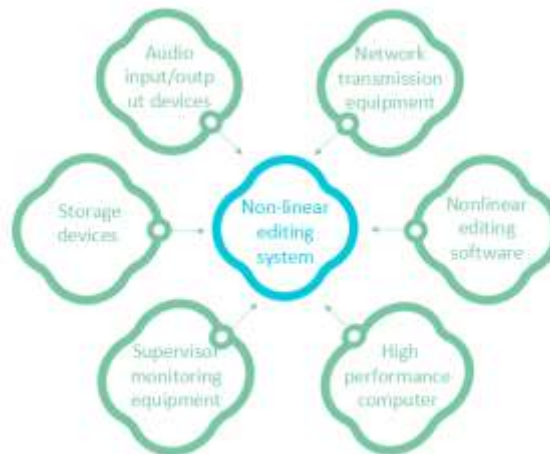


Figure 7. Non-linear editing system of teaching video.

The non-linear editing system of teaching video can be simplified to the following configuration: (1) high performance computer, (2) non-linear editing software, and (3) storage devices.

Packaging and Composing Teaching Video

Packaging and composing the teaching videos features the attributes of video production. For this reason, the composing processes of teaching videos are basically the same as those of general ones. Similar to the previous session, packaging and composing teaching video also has its own characteristics.

Generally, packaging and composing teaching video includes the following procedures: (1) adding title and credit, (2) adding subtitles, (3) adding screen package, (4) adding special effects, (5) adjusting screen color, and (6) determining the duration and format to output the finished piece.

Storing Teaching Video

Storing teaching video is relatively simple, as its main purpose is to properly store the produced teaching videos, for subsequent transmission and backup.

According to the teaching video element method, it can be concluded that the technical period of application consists two sub-elements: (1) transmitting teaching video and (2) applying and giving feedback of teaching video.

Transmitting Teaching Video

The discussed transmission of teaching video has the following procedures: (1) selecting teaching media based on the video's characteristics, (2) selecting the channels based on the target audience (learners), (3) developing the plans based on the target audience (learners), and (4) implementing the transmission of teaching video. Obviously, the above procedures cover two aspects: the theories of teaching media and educational transmission.

Nowadays, the mainstream teaching audio-visual media includes films, television, multimedia device, network media, mobile media, 3D media, VR, and AR.

Different screen sizes of the audio-visual teaching media have a great impact on the teaching effectiveness and environment. Since the mainstream teaching media have their own advantages and disadvantages in functions and properties, the selection of teaching media can be considerably complicated. In addition, no template is available for instant use. In other words, the selection of teaching media is not a benign logical inquiry system. Selection is shown in the figure.



Figure 8. Selection logic of teaching media.

There are five commonly used types of transmission channels for the audio-visual educational media, and each of them has its unique features.

The transmission mode of conventional storage media has been less and less used due to its high cost, low efficiency, and complicated operations. Relatively speaking, the transmission method of satellite signal is outdated and less interactive. It is one of the one-way modes of transmission, resulting in undesirable teaching outcomes. Internet transmission is the most commonly used channel for audio-visual media. The so-called network transmission actually means the transmission of human information (including news and knowledge) via the computer network. Mobile Internet is the latest and hottest mode of transmission, combining the mobile communications and the Internet.

However, the above five common modes of transmission for teaching video are rarely applied alone in practice.

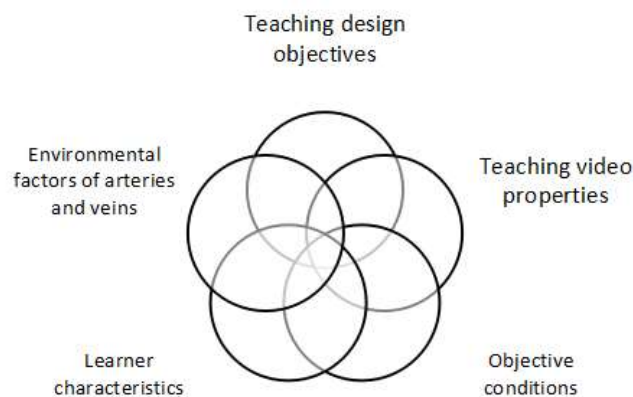


Figure 9. Elements of teaching video transmission.

Elements of teaching video transmission fully reflect the selecting principle of transmission media for the teaching video.

Applying and Giving Feedback of Teaching Video

The feedback of teaching video focuses on the outcome, including two aspects: the outcome feedback of the teaching video itself and the non-teaching elements of teaching video.

The evaluation period:

According to the teaching video element method, it can be concluded that the technical period of evaluation consists of two sub-elements: (1) testing the measures of teaching video and (2) processing information via education research management organization.

Testing the measures of teaching video is conducted by the production department of teaching video, including the self-test and joint test with the supervision department.

Processing Information via Educational Research Management Organization

This is the last elementary process in the full-process operation system of teaching video model. In summary, the structural construction of teaching video is inseparable from the analysis and

exploration of full-process system of teaching video. Almost every elementary process is directly related to the structural construction of teaching video.

Dynamics Analysis and Interpretation of Proposed System

Guided by the transfer concept, the systemic dynamics modeling is adopted to design the proposed system model. It is not a static process system of theories and logics, but a circulatory system of dynamic development. The systemic dynamics causal diagram for the proposed system is shown below.

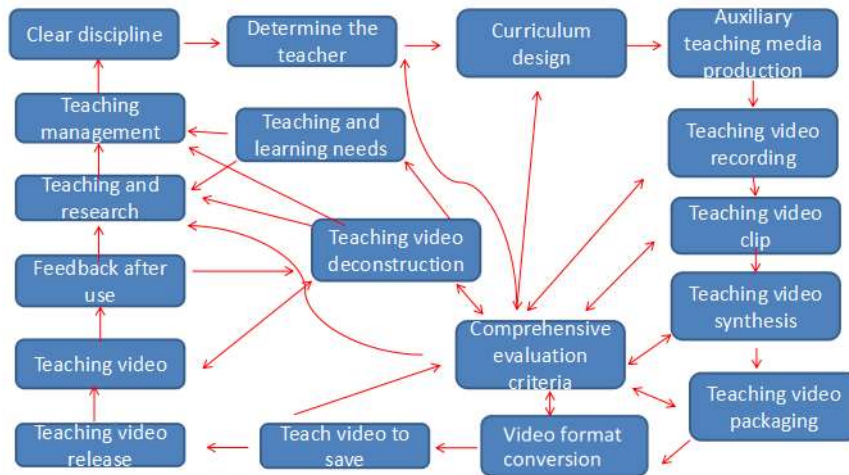


Figure 10. The dynamics causal diagram of teaching video full-process operation system.

The momentum that puts these links together and in motion must be related to the activities of people involved in teaching. In this paper, it is called teaching-related dynamics, which should possess the following attributes: (1) education, (2) ideology, (3) objective, (4) stability, and (5) sustainability.

The carriers of the teaching-related dynamics in the proposed system are all kinds of information flows related to teaching video. The basic information that constitutes the flows can be divided into the following categories: (1) media digital information, (2) administrative instruction information, (3) relevant technical information, (4) process feedback information, (5) educational philosophy information, (6) communication information, (7) related data information, (8) regulatory information, (9) interpersonal affective information, and (10) incidental information.

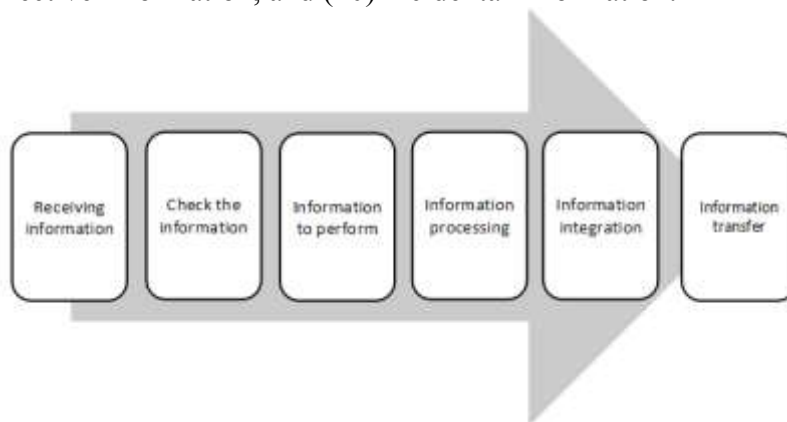


Figure 11. Information operation schematic diagram of teaching-related dynamics.

In summary, the teaching-related dynamics is essential in the theoretical framework of the full-process operation system of teaching video.

Analysis and Interpretation of Framework Structure of Proposed System

Based on the previous sections, the modeling idea and process of systemic dynamics are employed in the design of the full-process operation system of teaching video. Moreover, practical experiences and related theories are combined to derive the framework structure of the full-process operation system of teaching video. It is a complex research system with the specific technical processes as its elements, covering all the details of production, application, and evaluation of teaching video. It is one of the theoretical basis of this paper. According to the above framework diagram, it can be concluded that the proposed system is a three-dimensional research framework with chain, loop, interactivity, openness, and sustainability.

First of all, the chain in the proposed system framework means that all the processes are interlocked in a unified operating direction, and thus the structural system is well conducive. The loop in the proposed system framework means that system does not operate only once, but can be infinitely repeated under certain conditions. The loop in the proposed system is embodied in all the technical processes, also denoting the repeated operation of all the technical elements. The interactivity of the proposed system emphasizes the interaction of information, which is investigated in two levels in this paper: the interaction within the system and that between the system's inside and outside. The openness of the proposed system means that system is not isolated or closed, and that both the inside and outside of the system have a positive communication with other areas. Finally, the sustainability of the proposed system means that the proposed system has not only one static circulatory process, but also multiple possibilities of constant evolution.

Analysis and Interpretation of Functionality of Proposed System

The functionality of the proposed system is investigated from two perspectives. The first one analyzes and interprets the functions of the subject and each unit of the system according to its structure, definition, and processes; while the other approaches from the specific uses of the proposed system by different groups.

The specific functions are as follows: (1) guidance, (2) detection, (3) supervision, (4) research, (5) evaluate, (6) feedback, and (7) others.

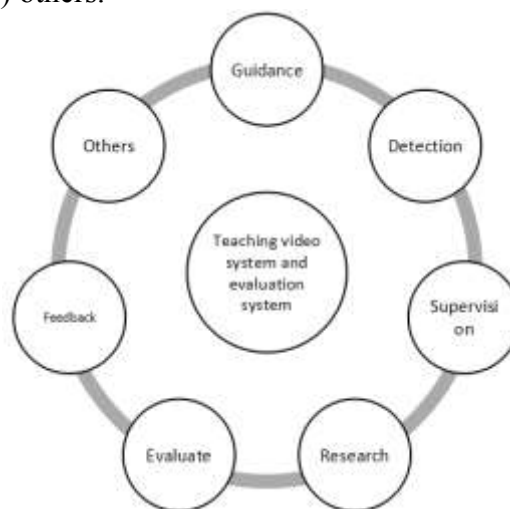


Figure 12. Functions of the processes of the proposed system.

In particular, the guidance function enables the teachers to inquire the processes and obtain theoretical and methodological guidance to the course design of teaching video via the system. It enables students to know how to choose the appropriate teaching videos and how to properly learn with the teaching videos. It enables the video producers to know not only the processes and requirements of producing teaching videos, but also how to use the related elements to achieve better teaching performance for each discipline.

The detection function enables the video producers to detect the processes and their quality data. It enables the transmitters to use different channels and methods to detect the transmission outcome. Given the full-process logic and management of the production and application of teaching videos, the detection function enables the teaching managers to detect the quality and data in the production and application of teaching videos.

Given the full-process logic and management of the production and application of teaching videos, the supervision function is used along with the detection one. For education management organization, supervision is a routine work, including self-supervision and external supervision. In particular, the external supervision covers the institutionalized supervision for the teachers, video producers, video transmitters, and learners. Supervision is implemented by examining whether the established provisions are followed and whether the test data are met.

The research function enables the teachers to use the system to design innovative teaching videos. It enables video producers to not only optimize the production of teaching videos, but also explore the artistic expression for various disciplines. Given the full-process logic and management of the production and application of teaching videos, the research function is of significance on two levels. Firstly, the education management organization's own research agencies, or the hired institutions outside the system, use the structure and methods of the proposed theoretical framework to carry out comprehensive and targeted scientific researches on the activities related to the production and application of teaching videos. Secondly, self-study of the system is performed.

The evaluation function enables the teachers to deliver reflective evaluation of their works, as well as the communicative evaluation on advantages and disadvantages throughout the production and application of teaching videos. It enables the education management organization to perform self-evaluation and non-self-evaluation.

The feedback function enables the teachers to timely send various kinds of valid information to the corresponding sectors or departments. It enables the students to simply send any questions to the corresponding platforms or teachers via various channels. It enables the video producers to collectively submit the technical and artistic problems generated during the production to the corresponding departments or platforms. By doing so, they manage to provide data and experiences for the future improvement in producing the teaching videos. The function enables the video transmitters to collectively submit the questions and experiences obtained during the transmission to the corresponding departments or platforms, so as to provide data and reference for future transmission of teaching videos. Given the full-process logic and management of the production and application of teaching videos, the feedback function refers to the internal and external feedback.

The remaining ones among the seven major types of functions are either rarely used or the non-essential ones yet to be developed, which would not be discussed here.

Table 1. Table of relationship between applicable groups and systemic functions.

System functionality	Guidance function	Detection function	Supervision function	The function of	The evaluation function	Feedback function
Use the crowd						
Teachers'	apply	apply	nothing	apply	apply	apply
student	apply	nothing	nothing	nothing	nothing	apply
Video producer	apply	apply	nothing	apply	nothing	apply
Video communicator	apply	apply	nothing	apply	nothing	apply
Teaching manager	apply	apply	apply	apply	apply	apply

As suggested by the above figure, education management organizations use all the functions of the proposed system. The video producers use the guidance, detection, research, and feedback functions, so do the video transmitters.

Contextual Problems about the Proposed System

Based on the previous sections, all technical elements in the proposed system are related to teaching videos. In this paper, the contextual problems about the proposed system are discussed in five main dimensions.



Figure 13. Five dimensions of production outcome of teaching videos.

Culture and institution, objective science and technology, interpersonal relationship, and human introspection, as well as other aspects besides them, are the five major dimensions influencing and evaluating the production outcome of the teaching videos^[4].

Firstly, the dimension of culture and institution. The two combined form a mental impact from the external reality upon people. Different cultures and institutions give rise to diverse customs and habits, producing diverse teaching methods and learning approaches. As one of the context of the proposed system, culture and institution are of great importance. Therefore, their influences must be fully considered when the other processes in the system of interest are stable. By doing so, the production of teaching videos can be completed as planned, achieving the desired results. Secondly, the technological dimension. From a macro point of view, technological changes will alter the mode of production, productivity, and social philosophy. From a micro point of view, they can change people's skills and even ideas.

The technological dimension is the basis for setting standards on production and evaluation of teaching videos, as well as an important reference for the spiral development of the proposed system. Thirdly, the introspective dimension. This one is different from the previous two, as they belong to the objective external factors while introspection belongs to the subjective internal factors. The introspective dimension is important for the proposed system and its influences cannot be ignored when producing and evaluating each teaching video. Fourthly, the interpersonal dimension. The influence of this one as a contextual element cannot be underestimated. Compared with the previous one, "interpersonal" is more interactive and communicative. Good interpersonal relationships can promote the activity and efficiency of individuals, so as to release the potential of the entire team. On the contrary, poor interpersonal relationships hinder the individual's growth and performance, even compromising the operation of the entire proposed system.

In conclusion, this paper presents a macroscopic system research on the teaching videos, by deliberately describing the various attributes of the entire proposed system and deeply exploring the elementary processes of teaching videos. It is hoped that this study can provide a theoretical basis for the future research on teaching video production as a stage result of the structural research on teaching

videos. Furthermore, it is also hoped to provide theoretical guidance to the producing practices of teaching videos.

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