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VISUAL CODING SYSTEM FOR TEACHING ELEMENTS IN CLASSROOM ASSISTED BY VIRTUAL TEACHING RESEARCH

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Abstract: In the new form of digital education, it is necessary to develop a visual coding and analysis system for teaching elements in the classroom. Based on marking, assigning values, implementing in C or Python, an innovative visual coding system has been developed assisted by virtual teaching research.It can optimize classroom activity models, strengthen sociological research tools, and empower digital education.
Keywords: Digitalization of education; Classroom elements; Educational software; Virtual teaching research

1 INTRODUCTION

In the current digital education, there is an urgent need for a visual coding and analysis system for classroom teaching elements. Foreign countries began studying teacher teaching behavior as early as the 1970s[1]. Research has shown that the diagnosis of information-based classroom teaching has great potential for development in standard setting, result verification, human-machine collaboration, functional diagnosis, non-interference collection, actionable insights, real-time feedback, and personalized recommendations[2].China was exploring localized teaching evaluation models based on learning from foreign experiences[3-4]. Information technology has made classroom behavior analysis more intelligent[5-6], but there is still room for development in information-based classroom teaching diagnosis[7-8]. The formation of distinctive classroom teaching in our country helps promote educational equity, and the "three classrooms" have received attention, expanding the focus of research from teaching quality to educational equity[9-10]. However, classroom systematicity have been overlooked by previous studies, so there's a need to use information technology to provide in-depth support for classroom research. This article comprehensively reveals the process of classroom occurrence, provides support for vertical tracking and horizontal comparative research, provides services for educational practice institutions and personnel, and improves the discourse system of educational research methods.
In the work plan of the Chinese Ministry of Education from 2020 to 2024, there was a discussion on comprehensively strengthening the construction of primary teaching organizations, thus virtual teaching and research has become a trend. Virtual teaching and research room is based on the functional and organizational innovation of primary physical teaching and research rooms in universities in the information age. It builds courses of excellent teachers into online open courses, and creates cross school virtual teaching and research teams through cross time and space co construction and sharing. It updates teaching resources, improves teaching platforms and learning tools, and cultivates the creative learning ability of teacher-student teams. Therefore, it is possible to code classroom teaching on virtual teaching and research platforms.

2 DATA PREPROCESSING OF CLASSROOM EDUCATION ELEMENTS

2.1 Definition and Classification of Educational Elements

The educational elements in the classroom include teachers' language expression, body movements, students' verbal responses, behavioral operations, and interactive communication between teachers and students[11].Classroom as the subsystem under the education system is a relatively independent ecosystem[12].These elements interweave with each other, forming a complex and dynamic classroom ecology. For example, a teacher's questioning (language element) may trigger students' thinking and answering (language element), accompanied by interactive behaviors such as focusing on listening or actively raising hands (action element).

2.2 Data Collection and Organization

2.2.1 Classroom recording collection

Using high-definition camera equipment to record the classroom teaching process from multiple angles in all aspects, ensuring that every teaching detail is recorded. At the same time, professional recording equipment is used to ensure collecting clear sound, in order to accurately analyze the language of teachers and students in the future.

2.2.2 Text transcription

Translate the audio content in the classroom recording word for word and sentence by sentence into written form,

forming a detailed classroom teaching transcript. In the transcription process, the principle of accuracy must be strictly followed, and mark the speaker (teacher or student) and speaking point of time of each sentence to provide accurate raw data for subsequent coding.

2.2.3 Marking and assignment strategy

In order to facilitate subsequent digital processing, various educational elements need to be marked. For teacher language, it can be classified and marked according to functions such as teaching introduction, knowledge explanation and questioning inspiration, and corresponding numerical values can be assigned based on the importance and emotional tendency of the language. For example, the language used to explain key knowledge points is assigned higher values, while simple transitional phrases are assigned lower values. Similarly, detailed labeling and assignment should be established for teacher actions (such as blackboard writing, instructions, walking range, etc.), student language (accuracy, completeness, innovation in answering questions, etc.), and student actions (participation in discussions, contribution to group cooperation, etc.)

2.2.4 Data screening and exclusion

After collecting a large amount of classroom data, it is inevitable to have some noisy data. Such as teacher's slip of the tongue, students' irrelevant chatter, or abnormal records caused by equipment malfunctions. By setting reasonable data screening standards, identifying and eliminating these invalid data, ensuring the accuracy and validity of the data, and providing a reliable data foundation for subsequent software design (Figure 1).

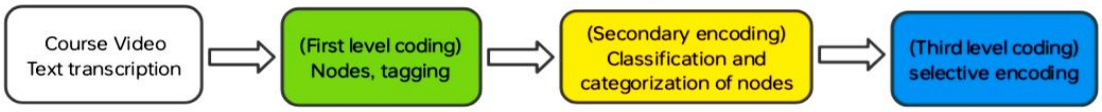

Figure 1 The Path of Obtaining Encoded Data

3 STRUCTURE AND PARAMETER OF CLASSROOM STORYLINE

3.1 Relationship between Educational Elements and Observation Points of Classroom

Under the guidance of educational theory, analyze the intrinsic connections between educational elements. For example, there is a causal relationship between teachers' effective questioning and students' deep thinking and positive responses, which has a significant impact on imparting classroom knowledge and the cultivation of students' abilities (classroom output). Quantify the contribution of these relationships to classroom output by determining observation points such as teacher-student interaction frequency and student engagement.

3.2 Construction of Structural Model

Construct a structural model of classroom storylines based on educational elements relationship and observation points. Taking the teaching process as the main thread, the teaching behavior of teachers, the learning behavior of students, and the interactive links are taken as nodes, and directed line segments are used to represent the order and logical relationship between behaviors. For example, connecting the students' practice and feedback section after teacher's explanation of new knowledge, and then direct towards teacher's summary and evaluation. At the same time, assign corresponding parameters to each node and connection, such as the duration of behavior, participation proportion and so on to accurately describe the characteristics of the classroom storyline.

3.3 Core Modules and Reliability and Validity Design

Determine the core modules of software design based on the structural model. For example, the data collection module is responsible for collecting classroom education element data; The relationship analysis module is used to analyze the logical relationships between educational elements; The storyline construction module generates classroom storylines based on the analysis results; The visualization module presents the storyline in an intuitive interface; The evaluation module tests the reliability and validity of the software. Among them, the design of reliability and validity is particularly crucial, and validate the performance of the software in reflecting the real classroom situation (validity) and ensuring the stability and reliability of data processing (reliability) by comparing it with traditional teaching evaluation methods.

4 VISUAL INTERFACE DESIGN AND SOFTWARE IMPLEMENTATION

4.1 Principles of Visual Interface Design

In order to clearly present the logical relationship of classroom educational elements, visual interfaces should follow the principles of simplicity, intuitiveness, rich information, and strong interactivity. Use appropriate graphic elements (such as flowcharts, node diagrams, etc.) to display classroom storylines, distinguish teacher behavior, student behavior, and interactive segments with icons of different colors, shapes, and sizes, and showcase the progress of the teaching process through dynamic effects (such as flickering, flowing lines, etc.). At the same time, interactive buttons are set up to

facilitate users in viewing detailed data, adjusting parameters, and switching different visualization modes.

4.2 Choose the Appropriate Development Language and Platform

Taking into account project requirements, development difficulty, software performance, and other factors, C or Python is chosen as the main development language. C language has the characteristics of high efficiency and speed, suitable for processing large amounts of data and complex algorithms; Python language has the advantages of simplicity, readability, and rich library resources, making it easy to develop and implement visual functions quickly. At the same time, by combining the use of platforms such as Matlab and utilizing its powerful mathematical calculations and data visualization capabilities, provided richer analysis and display methods for the software.
Choose a suitable computer language, such as Python, and implement visualization software based on relevant data processing and visualization storehouse.Utilize Python's data processing capabilities to analyze and calculate preprocessed data, and create various types of visual charts with the rich functionality of visualization libraries. Develop at least two different styles or functional focuses of visualization software to meet the needs of different users, such as educational researchers, teachers, educational administrators, etc.

4.3 Solution and Technology Route

Figure 2 shows the overall plan for developing the above system, from which the specific technical route can be refined, namely, from literature research and classroom recording, to data digitization and data preprocessing, and finally iterative classroom analysis system through machine learning.

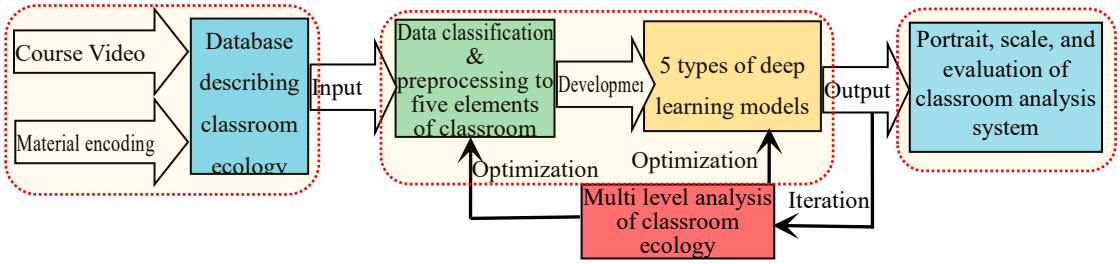

Figure 2 The Research and Development Plan

4.4 Methods for Developing Classroom Ecological Models

Preprocess classroom data by filtering, rotating, translating, and scaling. Set the training and testing data sets at 7:3, and establish five deep learning neural network models corresponding to the five elements of the classroom (this model is modeled after and abstracted from biology from the perspective of information processing, which is more in line with the classroom teaching ecology).
For the algorithm of deep learning neural network models, stochastic gradient descent algorithm will be chosen because it is more suitable for data systems with many variables, complex data relationships, and difficult to model. This algorithm is easy to get rid of the entanglement of local optimal solutions and run quickly.

5 CONCLUSION

This study utilises the interdisciplinary approach to digitize classroom elements and develop software. From data preprocessing to the construction of classroom storylines, and then to visual interface design and software implementation, the entire research process and key technical links are systematically explained. By delving into the application of educational element relationship theory in software design,providing theoretical and practical references for digital innovation in the field of education.
Future research can further expand the scope of educational elements, optimize software performance, enhance its adaptability and effectiveness in different educational scenarios, and promote the sustainable development of educational software engineering.

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COMPETING INTERESTS

The authors have no relevant financial or non-financial interests to disclose.

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