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Research on the Path of Higher Education Teaching Reform from the Perspective of Big Data

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Abstract: The advent of the digital age has pointed out the direction for the development of higher education. In this paper, the undergraduate course "Science of Interrogation" is taken as the research subject, the challenges of big data teaching reform in universities are analyzed systematically, and concrete measures, such as adhering to the concept of teaching reform under the condition of big data, establishing professional teaching teams, improving the curriculum construction level, emphasizing on being student-centered, and optimizing the reform of the curriculum evaluation system, are proposed to address these challenges.

Keywords: Big data; Higher education; Science of Interrogation; Teaching reform

Online publication: May 8, 2023

1. Introduction

With the profound integration of the internet, big data, artificial intelligence, and the real economy, big data is supporting the government in scientific decision-making and social governance. In this new era, all aspects are supported by big data, including the government's promotion of social governance, enterprises' product design, companies' participation in market competition, and schools' education. Police academies should take the initiative to adapt to the development trend of big data and carry out necessary teaching reforms. The question here is how classroom teaching can be promoted from the perspective of big data. In this paper, the undergraduate course "Science of Interrogation" is taken as an example to explore the feasible practice of curriculum construction in colleges and universities under the condition of big data in hope to provide reference not only for valuable research on big data, but also for a better undergraduate education development.

2. Significance of higher education teaching reform

With the promulgation and implementation of relevant policies and regulations, such as China's Education Modernization 2035, the Implementation Plan for Accelerating Education Modernization (2018–2022), and the Implementation Opinions on the Construction of First-Class Undergraduate Courses, necessary reforms should be made to the teaching mode of colleges and universities. The implementation of the Platform for Action on Big Data will have a huge impact on all sectors, with higher education institutions, especially police academies, bearing the brunt. The integration of big data into teaching reform is no longer in a state of questioning "whether or not to reform" or "how to reform," but rather in a crucial stage of implementation. This requires colleges and universities to comprehensively sort out the teaching content and improve the quality of each course, reasonably raise the level of academic challenge, increase the difficulty and depth

of each course, as well as effectively improve the quality of course teaching [1].

At the present stage, police academies still face some difficulties in promoting big data teaching reform. First, due to the weak horizontal connections among colleges and universities, there are problems such as repeated construction of big data teaching platforms and inconsistent standards [2]. Second, the understanding of big data-related information among teachers is inconsistent, and their ability to teach under the background of big data is subpar. Third, there are obstacles to data sharing among colleges and universities. It is very common that big data application platforms are incompatible with each other and data cannot be shared. Fourth, big data teaching reform platforms in universities have insufficient maintenance resources, especially given their over-reliance on technology companies. These problems limit the depth and breadth of big data teaching reform in higher education.

3. Measures of teaching reform from the perspective of big data

Higher education teaching reform under the background of big data is a systematic project. In this paper, the construction framework and specific content of the teaching reform of "Science of Interrogation" are presented. See **Figure 1** for details.

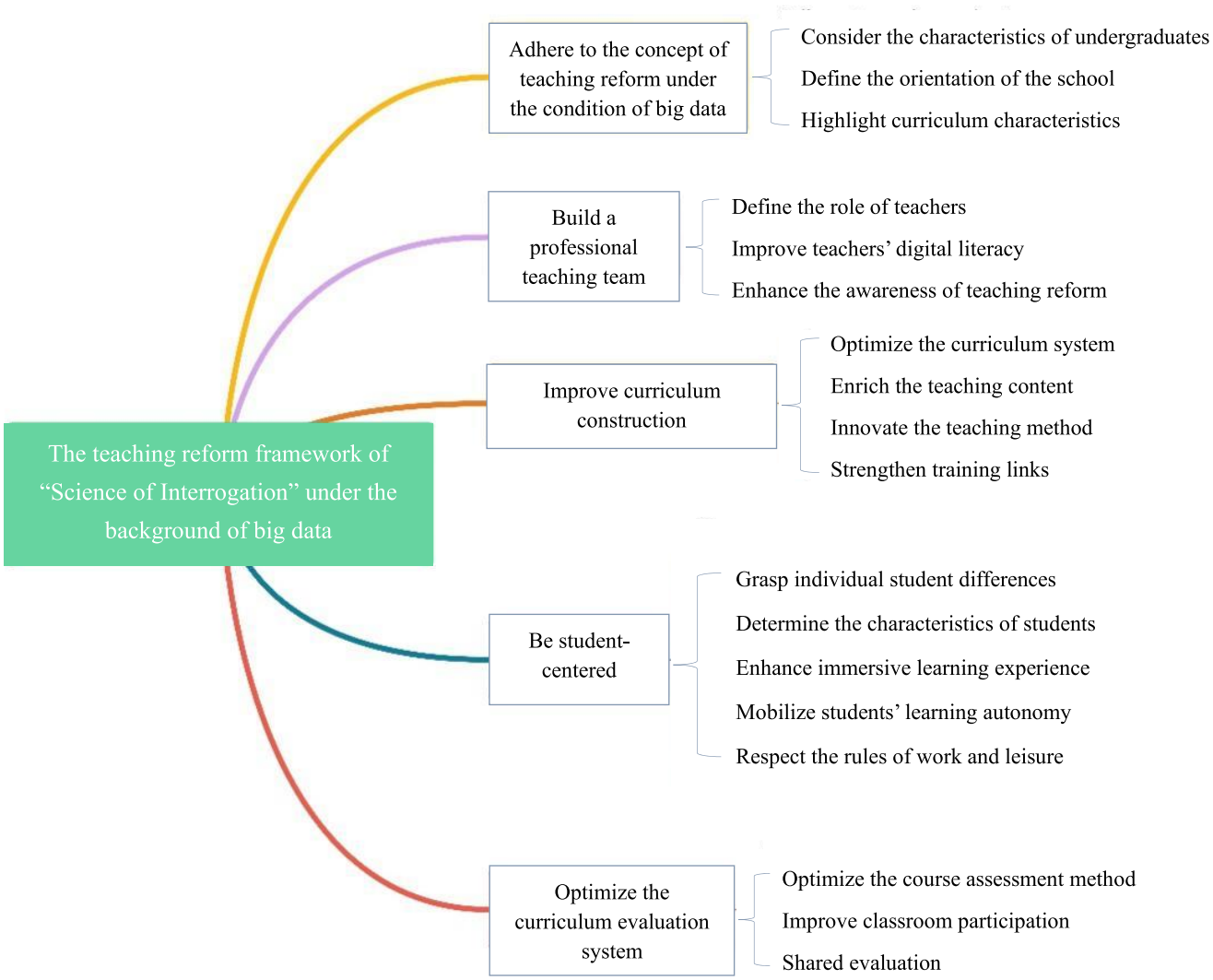

Figure 1. Course construction framework for "Science of Interrogation"

3.1. Adhere to the concept of teaching reform under the condition of big data

The direction of schools should be oriented around the professional police personnel training objectives, and scientific experimental teaching projects should be designed. The teaching content of the course should support the teaching objectives, and there should be a clear correspondence between the training content and the training requirements. In the design of the course, it is imperative to adhere to the law of undergraduate teaching and highlight the knowledge framework and rich contents. Case teaching should be the focus when teaching this course. Highlighting the course features of "Science of Interrogation," theoretical teaching should encompass about 20%–30% of the course teaching, while the remaining 70%–80% should be case teaching.

3.2. Build a team of professional teachers

On the one hand, it is necessary to improve teachers' digital literacy, help them understand and encourage them to accept big data teaching reform, form a team of teachers to highlight the characteristics of big data in various fields, including writing educational reform papers, declaring educational reform topics, recording online lessons, carrying out teaching competitions, *etc*., as well as help teachers familiarize themselves with big data teaching software and hardware. On the other hand, it is also necessary to introduce high-end talents. We should pay close attention to the introduction of talents, while promoting the understanding of teaching reform. These talents may include experienced instructors or those with doctoral degrees. Especially with the advancements in electroencephalography (EEG), speech, micro expression, and other psychological testing technologies, the introduction of high-end talents may offer some benefits [3].

3.3. Improve the curriculum construction level

First, the curriculum system should be optimized. The optimization of the course should be in line with the content of the textbook. In general, the course is divided into five modules: introduction, subject of interrogation, interrogation strategy, interrogation implementation, and big data. Each module is designed with corresponding questions, reference materials, and cases. Big data-driven teaching model allows for more comprehensive information gathering and in-depth analysis and evaluation of information. Big data from public security organs should be applied to teaching and training [4], and interrogation techniques should be included in the training. The course content should include the characteristics and composition of the interrogation equipment, the preparation of the interrogation, the experimental group and the control group, the experimental observation and interrogation, the realization of interrogation strategy, and so on.

Second, the teaching content should be enriched with the principle of innovation. Teachers should be encouraged to update teaching cases regularly. On the one hand, the various forms of expression should be taken into account. Due to the characteristics of big data as a digital way of reflecting social existence or a form of social digital existence, it is considered to be diversified and multi-angled in various fields or dimensions [5]. On the other hand, when using big data resources and internal information resources from public security organs, the cases and data should be kept confidential, so as to achieve isolation, confidentiality, and traceability of data use. In this way, data would be used in a safe and controlled manner [6].

Third, the teaching methods should be innovated. Case-based teaching (CBT) should be implemented in the teaching reform. In public security academies, scientific and technological methods should be applied to the teaching practice. In order to meet the talent demand for public security informatization and promote professional public security education as well as the training of innovative personnel, a big data platform system has been established for police demonstrations and training [7].

3.4. Be student-centered

Firstly, the characteristics of students should be accurately defined. Excluding the influence of physiological maturity, Piaget holds that individual development is in fact the product of a large number of activities in the sense of practice, experience, environment, *etc*. [8]. The relationship between teachers and students should be improved, and the influence of "command," "obedience," and "discipline" on classroom activities should be subdued in police academies. In addition, emphases should be placed on student initiatives and the cultivation of students' investigative literacy in the learning process. This would improve students' understanding, thought process, and investigation skills.

Second, there should be an immersive learning experience. The lack of interaction between teachers and students in classroom, coupled with outdated teaching content, makes lessons less attractive to students, thus suppressing their enthusiasm in class and motivation for learning. As a result, students tend not to participate in class [9]. Therefore, in the design of the course, the characteristics of "The Times" should be considered and flipped classroom should be adopted to encourage participation in class. Modern information technology such as big data should be fully utilized to identify major problems and improve the courses or design high-quality ones [10].

Third, students' learning autonomy should be mobilized. The rules of work and leisure must be respected. For instance, students, on a daily basis, should have their breakfast, take part in formation assembly, and attend classes and physical training; at noon, they should have their lunch, while taking a break, and continue with formation assembly, classes, or physical training; thereafter, they should have dinner and attend evening classes. There is regularity in these links. Only by understanding this regularity can students better allocate their study time. Other than that, it is important to take into account of individual student differences. Nowadays, most college students are those born after 2003. Their height, weight, character, psychological quality, and personal skills embody the distinct characteristics of "The Times." These differences should be considered when making educational reforms.

3.5. Optimize the curriculum evaluation system

The course assessment should also be optimized. Several scholars have put forward the concept of "big data-driven investigation," emphasizing the subversive changes brought by big data to traditional investigation [11]. First, it is necessary to improve classroom participation. In the design of flipped classroom, it is important to group the students appropriately. Students' dormitory allocations can be used as the basis for grouping. Each group should consist of 6–8 members, and based on the participation, scores are given. The average score should be calculated after excluding the highest and lowest scores. Second, big data resources and methods should be taken as an important content of assessment, reflected in both the teaching link and the participation of students. The assessment results should be shared with other teachers and the students as constructive feedback. Finally, a scientific evaluation framework should be established as follows: course grade = usual class performance (15%) + assignment (15%) + mid-term test score (10%) + final exam score (60%).

4. Conclusion

The rapid development of big data application drives police academies to carry out teaching reform. There is a need to strengthen the construction of teaching teams and innovate the teaching ideas, teaching means, and teaching methods of "Science of Interrogation," one of the basic disciplines in police academies. This discipline is committed to police personnel training under the condition of big data and achieving the expected goals of teaching reform and curriculum construction [2]. Reform is a continuous endeavor, and there are still problems such as inconsistent reform standards, differences among colleges and universities, and the lack of sharing of reform effects. Looking forward to the future, relying on the big data teaching

platform, and upholding the concept of big data teaching reform, the teaching reform of "Science of Interrogation" will provide some reference to the teaching reform of other courses under the background of big data.

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Author contributions

The author confirms sole responsibility for the conceptualization and writing of the manuscript.

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Optimization of the Assessment Method Used in Web Design and Website Construction Course

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Abstract: In this article, the shortcomings of the existing assessment method used in Web Design and Website Construction course are analyzed, and the assessment method is optimized based on the practice of project-based teaching reform. The main idea is to take project implementation as the leading factor, increase the assessment proportion in the course teaching process, and assume actual static website design and implementation as the final assessment goal. This assessment method improves the shortcomings of existing assessment methods to a certain extent and comprehensively reflects the overall learning situation of students.

Keywords: Course assessment; Web design; Project-based teaching

Online publication: May 8, 2023

1. Introduction

Course assessment is a key link in course teaching. Through assessment, we will not only grasp the students' learning situation, but also determine whether the preset teaching objectives of the course are realized. Therefore, the setting of assessment methods has a significant impact on students' learning direction. In actual course teaching, due to the differences in each course, the setting of assessment methods varies. Currently, there are many research findings on the assessment methods used in Web Design courses. Liu, Pang, and others have conducted a process-based reform research on the assessment mode of Web Design courses. In their studies, they analyzed the characteristics of this process-based course assessment, redesigned the teaching evaluation system, and proposed a process-based course assessment plan [1,2]. Yang and Chang explored the assessment methods used in Multimedia Web Design courses based on two teaching models, *i.e.*, the massive open online course (MOOC) and flipped classroom models, as well as improved the teaching effectiveness of Multimedia Web Design courses through process-based assessment and diversified forms of homework submission [3,4]. Based on the certification background of engineering education, Huang has improved the assessment method of Web Design and Development Technology courses from aspects such as process assessment, assessment form, assessment content, and evaluation method [5]. In a study, Niu investigated the reform of course assessment models based on students' personalities and strengths, exploring the combination of teaching content and assessment models with students' personalities and strengths and fully leveraging students' personal advantages [6].

The above research results have different reflections on the current assessment status and models of Web Design courses, and the exploration of different optimization methods provides reference to the teaching reform and adjustment of assessment methods for Web Design and Website Construction courses.

2. Teaching status and existing problems

Web Design and Website Construction is one of the core foundational courses for e-commerce majors in the School of Economics and Management at Wuyi University. It is also an introductory course in the field of technology. The teaching objectives of the course are as follows: to cultivate students' technical skills in developing static websites; to familiarize students with the development process of static websites; and to lay a solid technical foundation for subsequent dynamic website development. At the same time, the course also intends to enhance students' basic knowledge reserves, so that they can engage in technical development and management work after graduation. This course has high practical requirements, and the total class hours are set to 48 hours, which are equally divided into 24 hours of theoretical learning and 24 hours of practical training. In the teaching process, a project-based teaching mode is mainly used, with the goal of achieving practical case pages, encouraging students to combine theoretical knowledge with practical application, and strengthening the cultivation of practical skills and professional literacy.

The original assessment method is based on the final exam, accounting for up to 70%, as well as attendance and usual class performance, accounting for the remaining 30%. Looking at the teaching situation in recent years and the feedback from students, the course team has found several problems with the existing assessment method: firstly, the assessment of usual class performance is not as detailed and quantified; under the outcome-based education (OBE) philosophy, any exercise or assessment content should have clear assessment standards; secondly, the proportion of scores from the final exam contributing to the overall evaluation is too high, resulting in the poor reflection of the practice effect in the final overall evaluation score; thirdly, the single assessment form lacks formative evaluation.

Therefore, after several semesters of teaching practice and accumulation of experience, the course team decided to carry out project-based and result-oriented teaching as well as implement a process- and result-oriented assessment model in Web Design and Website Construction, so as to better meet the needs of teaching reform, improve the quality of course teaching, stimulate students' interests, and enhance students' practical skills.

3. Optimization

In response to the shortcomings of the original assessment method of Web Design and Website Construction, and in consideration of professional training objective requirements, improvements have been made from two aspects: assessment method and assessment content.

(1) Adjust the proportion between usual class performance and final exam scores

In classroom teaching, the proportion of usual class performance is 50%, while the proportion of final exam scores is 50%. The usual class performance consists of attendance (accounting for 5%) and five exercises (accounting for 45%), with clear goals and themes for each exercise. In this way, the total proportion of final exam scores and practical scores can comprehensively reflect students' learning situation throughout the teaching process.

(2) Change the assessment method from test papers to assignments

In the past, open-book examination was the assessment method for this course. Open-book examination emphasizes more on the mastery of theoretical knowledge. However, for computer courses in general, in addition to basic theoretical knowledge, the comprehensive application of knowledge is highly emphasized. Therefore, changing the assessment method from test papers to assignments through actual project development not only evaluates students' understanding of basic knowledge, but also assesses students' comprehensive application of theoretical knowledge. Usual class performance assessment is based on the design and implementation of each individual page, whereas the final assessment is based on the design and implementation of the entire static website. The assessment focuses on combining theoretical knowledge with practical application.

(3) More comprehensive assessment content

In terms of assessment content, the original assessment content mainly focuses on professional theoretical knowledge points. Upon changing the assessment method, the first step is to integrate the ideological and political elements of the course, such as patriotism, professional ethics, scientific spirit, craftsmanship spirit, *etc*., into the selection of topics on the page or website, so that students will not only master computer technology, but also acquire socialist core values; the second step is in terms of professional and technical content assessment based on the idea of actual static website development, where students are required to first write website construction requirement documents and then design and develop based on the content of the documents. In the implementation process, students would need to apply the theoretical knowledge learned from books and thus achieve full integration of theory and practice as well as improve their practical and professional skills.

4. Assessment content arrangement

4.1. Usual class performance

In line with the optimization, the teaching content and assessment content of the course are adjusted.

The teaching content of the first chapter includes three aspects: basic format of HTML documents, text tags, and image tags. The following is the assessment content of the exercise: with the theme "Showcasing Traditional Chinese Culture," students are required to create a page to showcase their understanding of traditional culture through a combination of text and images and then test the effectiveness of the page. The proportion of this exercise is 9%.

The teaching content of the second chapter includes three aspects: CSS core foundation, CSS control text style, and CSS advanced features. The following is the assessment content of the exercise: with the theme "Showcasing of the Chinese spirit," students are required to create CSS documents on their own, define multiple types of styles, complete the graphic design on the page, demonstrate understanding of the Chinese spirit through a combination of text and images, and test the effectiveness of the page operation. The proportion of this exercise is also 9%.

The teaching content of the third chapter includes three aspects: related attributes of the box model, type and transformation of elements, and floating and positioning of elements. The following is the assessment content of the exercise: with the theme "The Spirit of the 20th National Congress," students are required to use div+CSS to design and realize multiple graphic pages in such a way to reflect their understanding of "The Spirit of the 20th National Congress." The proportion of this exercise is 9%.

The teaching content of the fourth chapter includes three aspects: list tag, CSS control list style, and hyperlink tag. The following is the assessment content of the exercise: students are required to comprehensively apply lists, CSS, and hyperlinks to realize the jump between the website's navigation bar and different pages, further improve the structure of the page and art effect, as well as enhance the website's access experience. The proportion of this exercise is also 9%.

The teaching content of the fifth chapter includes four aspects: understanding table-related tags, CSS control table style, form control, and CSS control style. The following is the assessment content of the exercise: students are required to create a static site, comprehensively apply CSS and forms, and complete the design and implementation of login and registration interfaces. The proportion of this exercise is 9%.

4.2. Final assessment

According to the assessment requirements of the OBE philosophy, the assessment content needs to be closely related to the teaching objectives of the course and have strong pertinence.

(1) For course assessment goal 1

To understand the basic knowledge of web design and be familiar with the basic process of website construction. The following is the assessment content: students are required to master the basic content of HTML language and the planning and design of website function modules, as well as gain familiarity with the main process of website construction.

(2) For course assessment goal 2

To master the use of HTML language to make static pages. The following is the assessment content: students are required to skillfully use HTML tags to complete the design and implementation of all static graphic pages according to the theme of the website and the classification of various columns.

(3) For course assessment goal 3

To master div+CSS to achieve page layout design and beautification. The following is the assessment content: students are required to comprehensively apply the above technology in line with the style requirements of the website theme, complete the layout design for all pages, ensure the consistency of page structure and style, ensure that the overall effect is alluring in terms of color, picture, text, style, and so on to meet the theme, carry out matching and coordination, and use their own CSS documents to achieve the management of all static page styles.

(4) For course assessment goal 4

To master the planning, design, and implementation of static pages and static websites. The following is the assessment content: students are required to design and implement static pages with consistent style and structure as well as a beautiful layout design based on the theme and integrate them into static sites through hyperlinks, navigation bars, and other technologies, so as to achieve standardized file naming, clear page material classification, reasonable column settings, thematic related content, easy browsing for users, and a smooth running speed.

5. Implementation effect

In the past three semesters, the revised assessment method has been implemented. Generally, in the first class of the course, the assessment method, assessment content, and basis are clearly explained, so that students would be able to understand the specific operation process and make timely adjustments based on the actual situation. At the end of the semester, the learning situation of students is determined, and feedback is obtained from students through a questionnaire survey. Our statistical data showed that most students find this assessment method relatively novel as it divides the necessary content into assignments for scoring, ensures that the final examination takes up a smaller proportion of the overall evaluation, and clarifies the goals for each stage in the learning process, combining some relatively dull theoretical content with actual development tasks, effectively enhancing the learning goals and enthusiasm of students, and also cultivating the spirit of teamwork among students.

6. Conclusion

Course assessment is a key link in teaching reform and plays an important role in improving teaching quality. In this article, Web Design and Website Construction is taken as an example, and the assessment method of this course is optimized in line with the practice of project-based teaching from three aspects. The actual implementation results showed that this assessment method is more scientific and reasonable. However, in terms of specific details, especially those difficult-to-quantify assessment indicators, further research is needed to set a more scientific scoring basis.

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Reform and Practice of Talent Training of Architectural Interior Design Professionals in Higher Vocational Skills Competition: Taking Chongqing Energy Vocational College as an Example

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Abstract: For higher vocational colleges, skills competition is an important indicator of professional personnel training quality. In this paper, the architectural interior design professional skills competition in Chongqing Energy Vocational College is taken as an example, the many years of teaching and competition experience are taken into account, the problems existing in the cultivation of architectural interior design professionals in higher vocational colleges are analyzed, and corresponding solutions are proposed.

Keywords: Vocational skills competition; Architectural interior design; Teaching reform

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1. Introduction

In the 19th National Congress of the Communist Party of China, two proposals were made. The first was to speed up the transformation from "Made in China" to "Created in China," from "Chinese speed" to "Chinese quality," and from "Chinese products" to "Chinese brands," while the second was to improve the quality of workers, promote the spirit of model workers and craftsmen, and create the social ethos of honoring labor and the professionalism of striving for perfection. According to the National Vocational Education Reform Implementation Plan, issued by the Ministry of Education, higher vocational colleges should take building morality and cultivating people as their fundamental task, as well as carry out ideological and political education throughout the entire process of talent training. Skills competition is an important means to test a school's education quality, social service capability, and education level. Guided by skills competition, the reform and practice of professional personnel training can nurture high-quality skilled and technical personnel who are able to meet the market demand. The architectural interior design major of Chongqing Energy Vocational College is the mainstay major in Chongqing. Since its establishment, it has relied on industry enterprises, integrated resources, and school-enterprise cooperation. Moreover, a "3+2" talent training model with industry characteristics has been established for architectural interior design majors. After learning theoretical knowledge and professional skills in school, students enter the workforce for internship, realizing the training goal of "school education + enterprise training + vocational qualification certificate." On this basis, it is necessary to carry out talent training reform and

practice with vocational skills competition as the starting point; enhance students' learning enthusiasm, initiative, and creativity through skills competition; and strengthen the talent training model that emphasizes on school-enterprise cooperation, production-education integration, and school-enterprise win-win development. Vocational skills competition should be taken as an opportunity to strengthen professional construction and carry out curriculum system and teaching reform [1-4].

2. Existing problems in the cultivation of architectural interior design talents in Chongqing Energy Vocational College

2.1. Inability of the curricula to meet the needs for applied talents in vocational skills competitions and enterprises

The "Bayu Craftsman Cup" architectural interior design competition organized by Chongqing Municipality is divided into four categories: architectural design construction drawing, architectural design bill of quantities compilation, architectural design construction organization and management, and detailed design. At present, there are insufficient courses related to the preparation of the bill of quantities for architectural design in the talent training program. At the same time, architectural design construction organization and management is offered in the first semester of junior year. The professional curriculum system mainly includes three modules: basic skills, construction drawing, and interior design. In "Bayu Craftsman Cup," construction drawing is mainly made according to the provided interior renderings, which mainly assesses the students' understanding of the functional layout of the interior space and materials, as well as the mastery of construction techniques [5]. The detailed design module mainly assesses students' mastery of materials and construction techniques. Therefore, materials and construction techniques need to be highlighted in training. In addition, attention should be paid to the preparation of the bill of quantities for architectural design and architectural design construction organization and management. The proportion of courses should also be increased. Since the competition items are out of touch with the professional talent training program, students cannot master relevant theoretical knowledge during the competition or improve their skills. As a result, students are unable to adapt to the requirements of the professional talent training program and thus unable to meet the practical skill requirements of employers.

2.2. Lack of connection between daily teaching and vocational skills competition

With the Ministry of Education's emphasis on vocational education, the country is increasing its investment in vocational education, and both teachers and teaching tools are constantly improving. However, in actual operation, many higher vocational colleges often face problems due to the lack of professional teachers. First of all, there is a lack of integration between the competition venue and the teaching venue. At present, most of the competition venues are off-campus training bases or enterprise training bases. However, due to the influence of factors such as business environment, school teaching conditions, and student quality, several competition items are out of sync with the teaching content. Secondly, as far as the current architectural interior design competition is concerned, the software that is used in the competition, ZWCAD, is inconsistent with the software used in daily teaching, and students have to re-learn software operations to prepare for the competition. The seriously out-of-touch project results in a paucity of students' analytical skills, knowledge application, practical operation skills, and understanding of construction technology. Thirdly, there is a lack of integration of competition resources and teaching resources. At present, teachers of interior design majors in higher vocational colleges are relatively weak, and there is a lack of professional teachers to guide students in competition activities and training. Therefore, teachers should integrate competition items into daily teaching content, so as to truly improve students' level of competition.

2.3. Low skill level of double-position teachers

Double-position teachers have gained certain achievements; however, due to various constraints, the current skill level of double-position teachers is still far behind the requirements of vocational skills competitions. Most double-position teachers do not have the time to participate in projects undertaken by enterprises, and their practical operation skills and construction experience do not meet the necessary standard for guiding students in vocational skills competitions. Teaching evaluation refers to the use of various methods by teachers to observe, record, and analyze students' learning situation according to certain teaching objectives and the comparison of obtained data with standards, so as to gauge students' level of learning and make reasonable teaching evaluations. Skills competition often focuses on the operation skills of the participating student in the process of completing the project. However, a gap exists between competition evaluation and teaching evaluation. Competition evaluation focuses on results, while teaching evaluation focuses on the process. Therefore, it is necessary to organically combine competition evaluation with teaching evaluation.

2.4. Lack of in-depth and effective school-enterprise cooperation

School-enterprise cooperation serves as a bridge connecting the needs of enterprises and the supply of talents by schools. Only when enterprises, universities, and talents form a cooperation in the process of talent training can the quality of talent training be improved. At present, school-enterprise cooperation remains at a relatively low level, and no effective school-enterprise cooperation mechanism has been formed.

3. Strategies for talent training of architectural interior design major in Chongqing Energy Vocational College

3.1. Reform the teaching mode

Under the guidance of vocational skills competition, the teaching mode of the architectural interior design major is reformed based on the reform of the curriculum system. In traditional classroom teaching, teachers are the center of education, and students are passive learners. It is difficult for students to exert their subjective initiative and creativity under the traditional teaching mode. Under the concept of "promoting learning through competition," in-class and extracurricular learning and practical training are carried out by introducing typical cases and project tasks in vocational skill competitions. Through "Internet +" and other advanced information technology means, subject knowledge and vocational skills are integrated, and there is comprehensive improvement in knowledge, skills, and quality through in-class learning, extra-curricular learning, and practical training.

(1) In-class learning is carried out by promoting teaching and learning through competition. By encouraging students to participate in the National Vocational College Skills Competition Interior Design Professional Selection Competition, significant outcomes have been achieved; at the same time, classroom teaching has been reformed by taking skills competition as an opportunity, and the "online + offline" hybrid teaching mode has been used for teaching.

(2) Extracurricular learning adopts the "online + offline" hybrid teaching mode. Through the establishment of an electronic resource library for architectural interior design major and the establishment of a training base for school-enterprise cooperation, co-construction, and sharing, the existing teaching resources have been integrated, optimized, rebuilt, and updated. In addition, actual project tasks and typical work tasks of enterprises have been included into the course content, with the establishment of the hybrid teaching mode. By introducing actual project tasks and typical work tasks of enterprises as the course content, the traditional "theory + practice" teaching mode is reformed. The "online + offline" hybrid teaching mode can be used to carry out practical training, and the organic combination of course content with vocational skills competition should be realized [6-8].

3.2. Reform the teaching content and methods

Teachers should change the traditional teaching methods, reform the teaching content and methods, take students as the main body, and cultivate professionalism among students on the basis of imparting knowledge. When teaching, teachers should expose students to the actual situation of the industry and enterprises, adopt flexible and diverse teaching methods, and pass on knowledge and skills to students. Teachers should also strengthen the cultivation of students' professional quality, guide students to establish a proper career outlook, help students understand the employment situation and prospects, as well as improve students' social competitiveness. For example, teachers can select excellent works from industry enterprises for case analysis when teaching, so that students can understand the design process in actual work, as well as invite industry experts and outstanding designers to hold lectures or write up reports at school. Based on the "Bayu Craftsman Cup" organized by Chongqing in recent years, the talent training plan should be adjusted accordingly, and related courses should be added. At the same time, the interior design construction organization and management module be offered in advance during the first semester of sophomore year. Through case teaching, open laboratories, *etc*., students' professional skills can be improved [9]. Practice has proven that this teaching method not only cultivates students' professional qualities, but also improves students' professional skills. Positive results have been achieved through this method, playing a significant role in promoting students' future employment.

3.3. Reform of the course evaluation method

Course evaluation refers to the comprehensive evaluation of students' learning process and results. It includes learning attitude, learning outcome, and learning process. The traditional evaluation method is a form of summative evaluation, which uses test scores as the only standard. This leads to the undesirable phenomenon that students pay more attention to knowledge than skills, focus on test-taking instead of innovation, and pay more attention to results than the process. For this reason, the course evaluation should be reformed in such a way that it focuses on both process evaluation and summative evaluation. In the course evaluation, the project-based teaching mode has been adopted, and a course evaluation system based on vocational skills competition, consisting of "in-class credit evaluation + project-based evaluation," has been formed. Through the organization and implementation of skills competition, the initiative and enthusiasm of students in learning have improved, and the teaching reform and development have been further promoted. Taking the course Interior Space Design as an example, the skills competition assessment content can be divided into three parts: task-oriented determination of course assessment objectives; task-oriented design of assessment content; task-oriented assessment. On this basis, the project-based teaching method is adopted to carry out course teaching. In practice, a course assessment system based on vocational skills competition has been constructed, and the course assessment objectives are determined based on "tasks"; the course content is designed by means of "project-based teaching"; and the course assessment content is driven by "job tasks" [9]. The course assessment is conducted in various forms, such as "on-site display of enterprises + display of works in skills competition + on-site debate."

3.4. Reform the double-position teaching team

In terms of the cultivation of double-position teachers, the school promotes teaching through competitions and strengthens the construction of double-position teachers, as well as actively carry out the reform and practice of the "1+X" certificate system for professional teachers. According to the requirements of the documents by the Provincial Department of Education, the "1+X" pilot work has been carried out in all majors of the school since 2017. Relevant training, assessment, and evaluation will be carried out for teachers participating in the "1+X" pilot work. In terms of developing a team of professional course teachers, the school regularly arranges professional course teachers to participate in various trainings, vocational

skills competitions, teacher forums, and other activities organized by industry enterprises to improve their theoretical knowledge and practical skills. At the same time, professional backbone teachers are encouraged to take on part-time jobs in enterprises, and enterprises' first-line production technology backbones and skilled craftsmen are invited to participate in the formulation of student training programs and the design of curriculum systems [10].

Considering the situation of double-position teachers in Chongqing Energy Vocational College and the demand for professional and technical personnel in the professional curriculum construction of architectural interior design, personnel from design institutes or interior design companies with excellent professional operation skills and rich construction experience are hired. When experienced designers are invited as part-time lecturers, they are trained in such a way to improve their professional theoretical understanding and teaching skills. In that way, their role as off-campus part-time teachers would be more stable. At the same time, encouraging professional course teachers to participate in specific design projects and cooperate with enterprises would help them grasp the entire process of interior design more systematically and meticulously, as well as realize the cooperation and integration of professional course teachers and professional enterprise personnel. This is a key step in forming double-position teaching teams.

4. Conclusion

Taking skills competition as an opportunity, integrating the project of skills competition into the professional talent training plan is conducive to promoting teaching reform and improving teaching quality, deepening the integration of production and education as well as school-enterprise cooperation, improving students' professional qualities, promoting the spirit of model workers and craftsmanship, improving teachers' professional understanding and skills in guiding students, and giving full play to the role of industry associations and providing technical services to enterprises.

Disclosure statement

The author declares no conflict of interest.

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Application of Mind Mapping in General Zoology Teaching

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Abstract: Against the background of the new curriculum reform, teachers are no longer just expected to impart knowledge exclusively, but they also carry the responsibility to encourage students to think independently, improve students' thinking skills, and cultivate good learning and thinking habits among students, so as to enable students to use knowledge in a flexible manner and improve their thinking skills. General zoology is a highly specialized discipline, with scattered knowledge points and various concepts. Since the traditional teaching mode limits students' mastery of knowledge points, teachers need to find a teaching method that can help students understand knowledge points and exercise independent thinking. Mind mapping is a concrete thinking tool that helps students exercise their thinking skills. The introduction of mind mapping in the teaching of general zoology allows students to have a clearer understanding of the overall framework of this discipline. The application of mind mapping can be divided into four parts: pre-class preview, classroom study, after-class review, and zoology experiment. The application of mind mapping to teaching not only improves students' learning efficiency, but also enhances students' comprehensive ability and stimulates their interest in general zoology. In this paper, the 17th chapter of "Fish" in general zoology is taken as an example to elaborate the application of mind mapping in the teaching of general zoology.

Keywords: Mind mapping; General zoology; Pisces; Classroom teaching

Online publication: May 29, 2023

1. Introduction

General zoology is a discipline that studies the morphological structure of animals and the laws related to their life activities. General zoology is one of the important professional foundation courses for animal science, biological science, and ecology majors [1]. The teaching objectives of general zoology are as follows: to enable students to understand the basic morphological structure and classification of different animal groups, as well as the basic skills of zoological research and knowledge of the taxonomic system of zoology; to understand the morphology, structure, classification, and evolution of animals; to understand the adaptation of animals to their environment, as well as the unity of structure and function [2]; to acquire the ability to analyze and solve practical problems in science and production in this process; and to lay the foundation for subsequent courses. Since there are many complex and fragmented knowledge points in general zoology, students not only find it difficult to learn and master the knowledge points, but also feel overwhelmed when learning. At present, the teaching process is generally faced with more teaching content, limited learning time, students' weak foundation, and their struggle to learn. Moreover, the traditional teaching method embodying systematic explanation as the main teaching method in the teaching process is still adopted [3]. This rigid teaching method subdues students' interest in learning and has poor teaching effect, thereby making it difficult to achieve the expected teaching objectives.

Mind mapping, as proposed by Dr. Tony Buzan in 1970, is a thinking tool that conforms to the laws of thinking [4] and a visual thinking tool that embodies divergent thinking, in which the relationship among topics at all levels is represented by a hierarchical diagram of mutual affiliation or correlation through the combination of graphics and texts, and the link between keywords of a topic and images and colors is used to create a link in memory [5]. The use of mind maps in general biology is a pedagogical way to help students better understand the subject matter and exercise their thinking skills. A review of literature concludes that the use of mind mapping as an augmentative tool in teaching can significantly increase the average score of students compared to traditional teaching methods. As an example, in a practical comparison by Pan [6], the mean score of the class in which teachers used mind mapping in teaching was 5.19 points higher than that of the class in which traditional teaching methods were used, and the standard deviations of class performance under mind mapping and traditional teaching methods were 15.216 and 19.359, respectively, indicating that the use of mind mapping can help maintain students' performance. The Z-score was 2.314, which corresponds to a *P*-value of less than 0.05, further indicating that mind mapping has a good effect in terms of improving students' performance [6]. Therefore, if teachers can make use of mind maps to teach general zoology interactively, it is possible to improve the classroom quality and the performance and motivation of students toward the course [7].

2. Problems in the teaching of general zoology

2.1. Diverse and varied course content

At present, there are some problems with the traditional teaching method. General zoology is a discipline that studies the morphological structure of animals and the laws related to their life activities. It has many teaching contents [8] of which the main contents are the main characteristics of animals and the interrelationship between various types of animals; the basic laws of the occurrence and development of the animal kingdom; and the cultivation of students' ability to analyze and solve related problems by applying zoology-related knowledge. Due to the numerous contents and scattered knowledge points, students might feel overwhelmed when learning.

2.2. Weak basic knowledge

The course "General Zoology" is generally offered in the first and second year of university. At this time, students have weak basic knowledge, as they not been exposed much. Since students are required to master numerous concepts and terminology in this course, understanding and memorizing would be challenging for students, thus resulting in poor learning effect.

2.3. Constraints of the traditional teaching mode

At present, most teachers still adopt the traditional teaching mode of one-way explanation in the teaching of general zoology. As a result, students tend to be confused and become tired easily given that the course content is already complicated and difficult to understand. This not only affects the progress of the course, but also causes students to lose interest in learning, which is not conducive to the achievement of the teaching objectives.

3. Significance of mind mapping

3.1. Enhances students' interest in learning

Many teachers in today's classrooms still use traditional teaching methods to teach. The traditional teaching mode has distinctive characteristics, namely being teacher-centered [9], mechanical, and rigid, as demonstrated by the exclusive instillation of knowledge and the mechanical repetition among students [10]. As a result, students have trouble remembering knowledge points, tend to lose interest in learning, and often

become indifferent in classroom due to boredom. There is strong logical aspect to mind maps. Hence, through mind mapping, students can build frameworks and integrate knowledge points by logical combing. This process not only reflects the subjectivity of students and the fun they experience by participating in it, but also enhances students' interest in learning.

3.2. Exercises students' thinking skills

The Ministry of National Education has emphasized that teachers should cultivate students' learning initiative and autonomy in the teaching process. Teaching is not only a process of imparting knowledge, but also a process of guiding students to explore [11]. When creating a mind map, students need to use their brains, eyes, and hands, as well as expand their minds and reasoning, to create a map that reflects their own thinking. This process fully exercises students' thinking skills.

4. Application of mind maps in theory classes

The application of mind mapping in general zoology aims to pique students' interest in classroom, so that they can learn more easily and master the knowledge points better. In this study, "Fish" is taken as an example to demonstrate the application of mind mapping in general zoology.

4.1. Students' independent study before class

According to Nelson, a biologist, fish species account for half of the number of named chordate species in the world, and it is now estimated that there are more than 26,000 species of fish. All in all, *Pisces* is a very large group. Therefore, students may find it difficult when learning about this topic. In order to prevent students from losing confidence and enjoyment in learning due to the complex and dense knowledge points, teachers can integrate and summarize the chapter and create a mind map that allows students to learn about the topic. The mind map can also be used by students in their own pre-class study sessions. In this way, students would be able to exercise their skills to learn independently and improve their learning efficiency [12]. **Figure 1** shows a mind map that can be used.

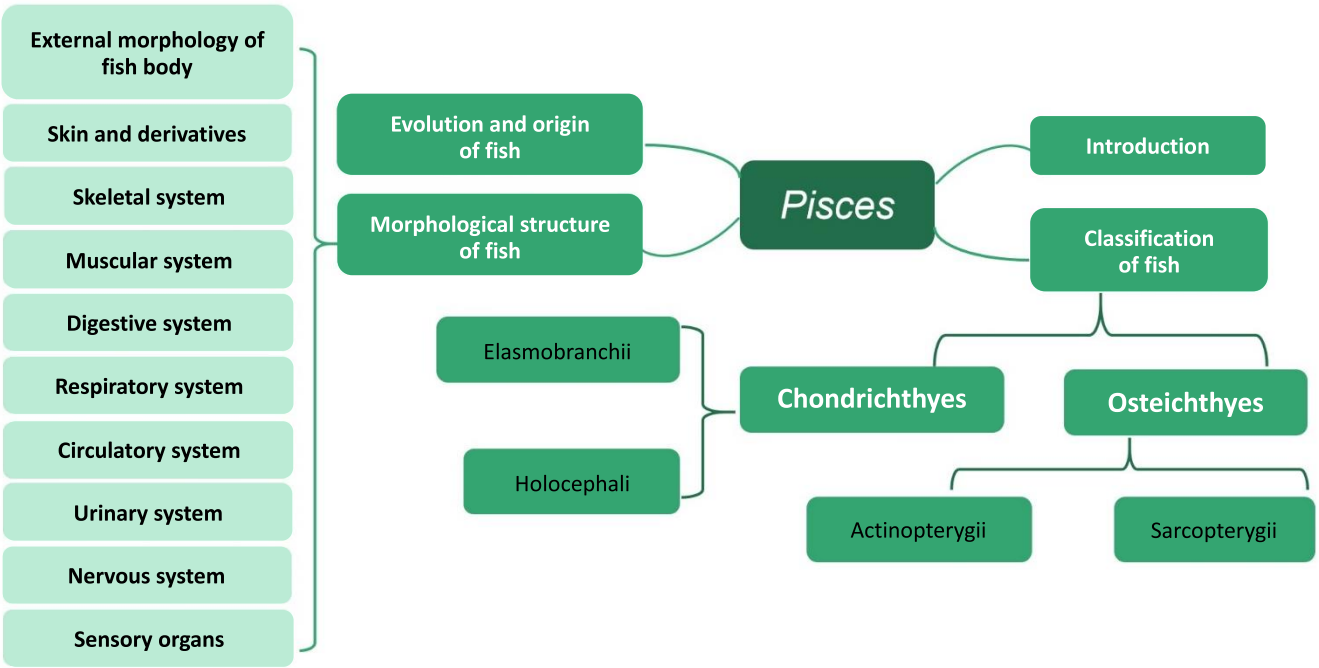

Figure 1. Example of a pre-class study mind map of fish

Firstly, "fish" is the central keyword, and branching out from the central keyword is "Introduction," "Morphological structure of fish," "Classification of fish," and "Evolution and origin of fish." Taking the morphological structure of fish as an example, students can further improve their understanding of fish by studying ten different aspects of fish: external morphology, skin and its derivatives, skeletal system, muscular system, digestive system, respiratory system, circulatory system, urinary system, nervous system, and sensory organs. Through this process, students will not only summarize in the pre-study and have an intuitive judgment of what they want to learn, but also find out what they do not understand in the topic, so that they can focus and listen during the lesson, thus improving their learning efficiency.

4.2. Teacher-led learning in classroom

In classroom, teachers can complete the mind map provided in the pre-class study stage by summarizing and refining the knowledge points and then share it with the students through courseware or blackboard-writing in a guided teaching manner. On the one hand, students can improve the mind maps given and refine them in their own way, which would not only greatly improve the efficiency of note-taking in class, but also encourage students to think about what they have learned in class and their knowledge of the topic; on the other hand, students can compare their own mind maps with the teachers' mind maps to see what they missed and identify the mistakes they made in the pre-class study stage. Then, they can revise them accordingly, recall their pre-class study process, and identify the reasons that led to the omissions and mistakes [13]. Through this, their concentration and ability to learn independently will improve [14]. In addition, teachers can evaluate students' pre-class study session by asking questions in class; for example, before giving the "Classification of fish" mind map, teachers can ask the students what they understand about classification of fish through their pre-class study or to come forward to complete the mind map. This will improve students' participation in class and stimulate their interest in learning [15-17]. Students would also be more impressed with the knowledge points they have added. The mind map in **Figure 2** can be used when providing the classification of fish. First, divide it into two outlines, Osteichthyes and Chondrichthyes, and then teach the students based on their features and classification. By using the mind map shown in **Figure 2**, students will be able to quickly grasp the focus of learning and improve their efficiency of listening.

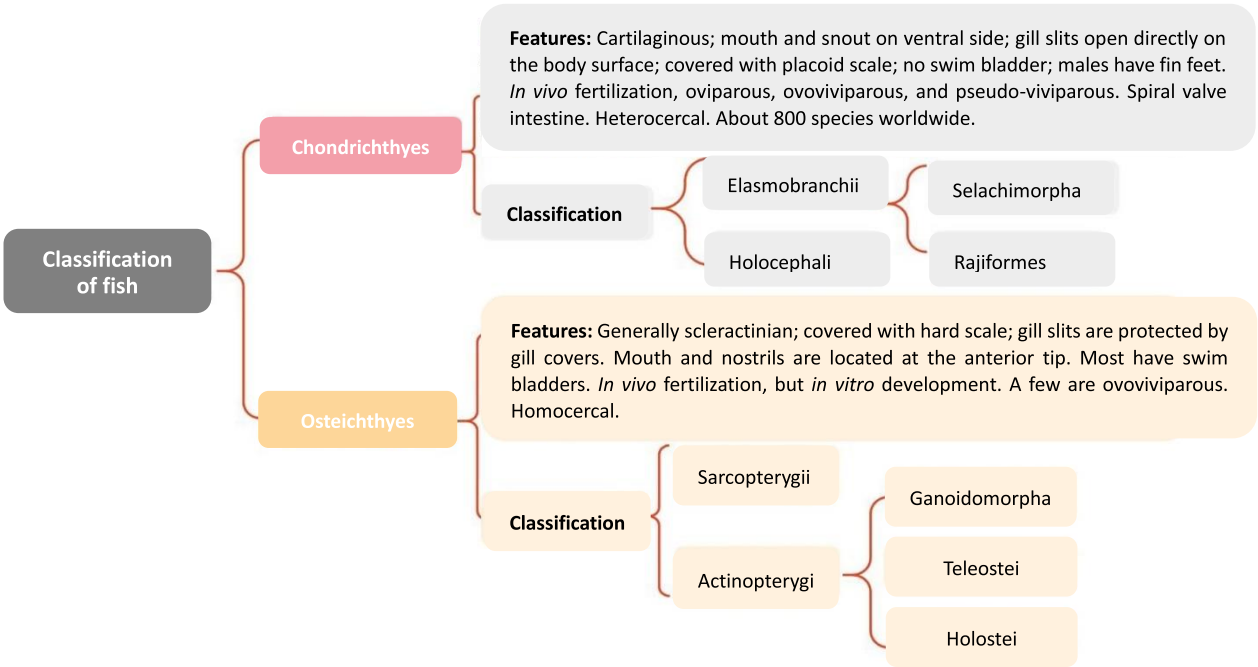

Figure 2. Example of a mind map of fish classification

4.3. Consolidation and review after class

The "Fish" syllabus is complex and wide, and students tend to feel overwhelmed when learning. Therefore, it is necessary for students to review it after class by using mind maps [3]. After completing the course preliminaries and listening to lectures in class, students would have developed a preliminary understanding of *Pisces*. By completing the mind map after class, students will develop their own insights into the fish family and form their own knowledge framework. This will help students sort out the structure of the chapter on fish and grasp the review focus and review in a targeted manner during the final review. In that way, the review process would be more efficient [18,19]. The main role of teachers at this stage is to answer questions posed by the students in the process of perfecting their mind maps, as well as to help students mark out the key points and sort out the differences between the various sections and topics of the syllabus. An example is shown in **Figure 3**.

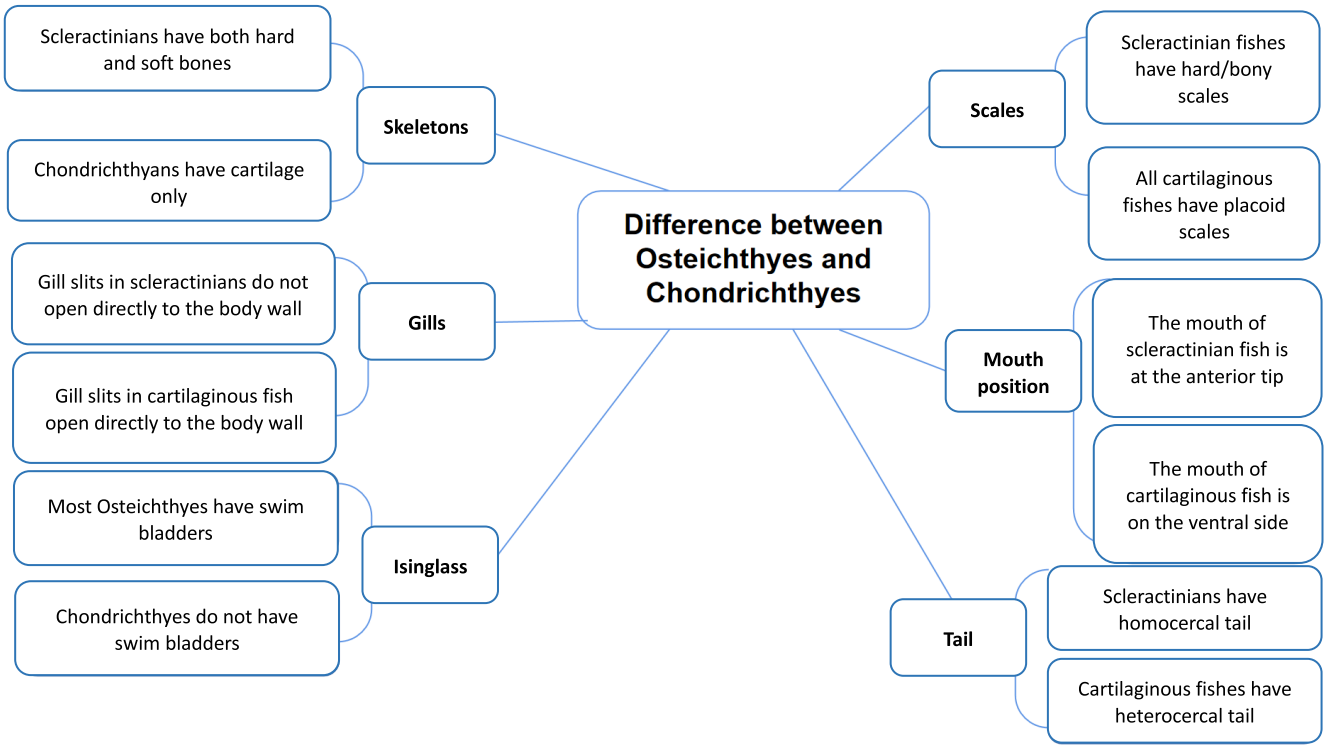

Figure 3. Mind map of the difference between Osteichthyes and Chondrichthyes

The differences between Osteichthyes and Chondrichthyes are as follows: (i) different skeletons; Osteichthyes have both cartilage and bone, whereas Chondrichthyes have cartilage only; (ii) different scales; Osteichthyes have hard or enameled scales, whereas Chondrichthyes have placoid scales; (iii) different gills; Osteichthyes branchial slits do not open directly to the body wall and have gill covers, whereas Chondrichthyes branchial slits open directly to the body wall; (iv) different oral positions; the mouth of Osteichthyes is at the front of the head, whereas the mouth of Chondrichthyes is on the ventral side of the head; (v) presence of swim bladder; most Osteichthyes have a swim bladder, whereas Chondrichthyes lack one; (vi) different types of tail; Osteichthyes have homocercal tail, whereas Chondrichthyes have heterocercal tail.

5. Application of mind maps in laboratory classes

The zoology laboratory course is an essential part of general zoology education because the learning of each phylum of the animal kingdom begins from the shape and internal structure of the representative

animals of each phylum. Through the observation and dissection of these representative animals, students will come to understand the appearance and internal structure of the animals more intuitively, thus consolidating their memory of the textbook content.

However, in zoology laboratory classes, students often do not have a firm grasp of the knowledge points taught by the teacher and are unimpressed by these knowledge points; moreover, they do not understand the questions raised by the teacher about the internal structure of the animal. If a mind map is used in laboratory classes, a mind map can be drawn in advance with regard to the experiment, experimental materials and supplies, experimental content, and experimental operations and observations [20,21].

Mind maps not only render the main content and process of experiments clear to students, but also allow students to reinforce what they have learned when drawing and deepen their understanding of the shape and internal structure of certain animals. For example, students can create a mind map similar to **Figure 4**.

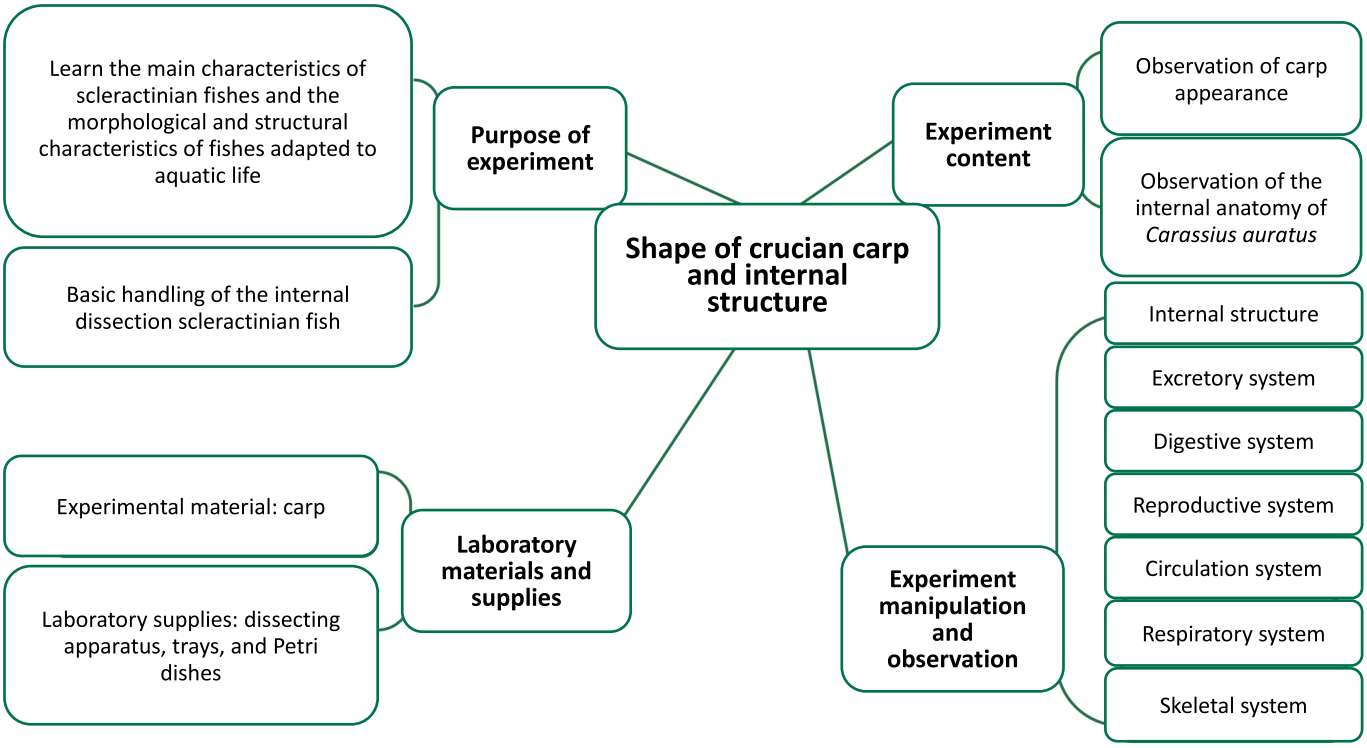

Figure 4. Mind map of the shape and internal structure of *Carassius auratus*

By using a mind map of the shape and internal structure of crucian carp, students would be able to follow the teacher's rhythm, answer the questions raised by the teacher, and also grasp the overall framework of the experiment, which would not only consolidate their memory, but also improve the effect of listening to the lecture.

6. Conclusion

General Zoology is a fundamental course for many biology majors. Due to the robust specialization and complexity of knowledge in general zoology, students' interest in learning may change precipitously, and the pace and progress of teaching may be affected to a certain extent. In this regard, the mind mapping tool can be used in pre-class study, classroom learning, after-class review, and laboratory classes. Mind mapping can change the way students learn from passive learning to active learning and pique students' interest in general zoology. By encouraging students to organize and summarize their knowledge from general

zoology textbooks to create a mind map for each chapter, they will be able to form their own knowledge framework and thus have a clearer understanding of general zoology as a whole. Mind mapping not only improves students' learning efficiency, but also encourages students to think more actively and improves their memory of certain knowledge points. In the process of drawing mind maps, students would also develop good habits of meditative thinking and independent learning.

Disclosure statement

The authors declare no conflict of interest.

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Research on BIM Course System and Ideological and Political Essentials of Cost Engineering Major

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Abstract: The era of information technology has dawned on the construction industry, and Building Information Modeling (BIM) is one of the necessary engineering skills for those engaged in civil engineering professions at present and those who will engage in these professions in the future. Therefore, top universities have begun exploring ways to increase BIM-related teaching content in the curriculum system. In this paper, we discuss the integration of BIM in an in-depth manner with regard to the four course modules offered by cost engineering majors (professional foundation course, professional core course, industry-oriented course, and professional practical course) and analyze the construction of BIM curriculum ideology and politics system, the setting of teaching objectives, and the key points of curriculum ideology and politics.

Keywords: Cost engineering; BIM technology; Curriculum ideology and politics system; Key points of curriculum ideology and politics

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1. Introduction

Building Information Modeling (BIM) is a data-based tool applied to engineering design, construction, and management. Through the integration of data-based and information-based models of buildings, they are shared and delivered throughout the whole life cycle, which embodies project planning, operation, and maintenance, thus enabling engineers and technicians to understand and provide efficient responses to various building information and forming design teams and construction entities, such as construction and operation units, to provide a basis for collaborative work and play important roles in improving productivity, saving costs, and shortening schedules [1]. In April 2021, the Ministry of Housing and Construction released the "Report on the Development of China's Construction Industry Informatization (2021)," proposing the vigorous development of digital design, smart production, smart construction, and smart operation and maintenance, as well as the acceleration of the development and application of BIM (as an important part of the informatization of the construction industry, the value of BIM is highly regarded by the government and generally recognized by the construction industry) [2].

2. Integrating BIM into the curriculum of cost engineering majors

The cost engineering majors offered by applied undergraduate universities should follow the development trend of the industry, update their personnel training programs in a timely manner, include BIM-related courses, and integrate BIM into the existing curriculum system. According to research on the teaching reform of many local and foreign universities, there are two specific optimized settings for BIM courses and relevant professional courses: (1) adopt independent BIM courses and (2) add BIM contents that match

relevant professional knowledge to existing courses (*i.e.*, "implantation") [3,4]. For example, in Chongqing Engineering College, the independent BIM courses "BIM Application," "BIM Application and Project Management (A)," and "BIM Application and Project Management Course Design" have been added to the professional foundation course, the professional core course, and the professional practical course, respectively. Through "implantation," "Introduction to Civil Engineering (A)" and "Civil Engineering Drafting (A)" have been included in the professional foundation course, "Construction Technology of Building Engineering" and "Application of Engineering Costing Software" have been included in the professional core course, and "Measurement and Pricing of Construction Works" and "Measurement and Pricing of Installation Works" have been included in the industry-oriented course. The optimization of the curriculum system is shown in **Table 1**.

Table 1. Optimization scheme for the integration of BIM into the curriculum of cost engineering majors

Course module	Course name	Optimization measures	BIM content	BIM software
BIM-based professional foundation course	Introduction to Civil Engineering (A)	Implantation	The application of BIM presents several classic cases in the field of civil engineering through a three-dimensional (3D) information model, allowing students to visualize the scope of research and development (R&D) in the field of civil engineering, consider the main issues involved in engineering construction, and gain a preliminary understanding of the concept, use, and importance of BIM.	Autodesk Revit
	Building Architecture (B)	Implantation	Using 3D models of buildings, students will be able to grasp the basic theory of civil building construction, familiarize with typical construction practices, and read common construction details.	Autodesk Revit
	BIM Modelling Application	New	Modelling of small building structures using Revit, a modeling software.	Autodesk Revit
BIM-based professional core course	Application of Engineering Costing Software	Implantation	Students will be familiar with the principles and methods of bill of quantities measurement and pricing and will be able to apply BIM civil measurement software to calculate quantities quickly and accurately.	Quanta BIM Civil Metrology Platform, Cloud Pricing Platform GCCP
	BIM Application and Project Management (A)	New	Students will be able to use BIM5D collaborative management for technology, production, quality, safety, and operations module applications.	Quanta BIM5D Platform
BIM-based industry-oriented course	Measurement and Pricing of Construction Works	Implantation	Students will be able to grasp the basic principles and methods of BIM construction calculations.	Quanta BIM Civil Metrology Platform GTJ
	Measurement and Pricing of Installation Works	Implantation	Students will be able to grasp the basic principles and methods of BIM installation calculations.	Quanta BIM Installation Metrology GQl

(Continued on next page)

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Course module	Course name	Optimization measures	BIM content	BIM software
BIM-based industry-oriented course	Municipal Engineering Measurement and Pricing	Implantation	Students will be able to understand the basic principles and methods of BIM municipal calculations.	BIM Municipal Metrology GMA
BIM-based professional practical course	BIM Application and Project Management Course Design	New	Students will be able to apply BIM to actual projects and produce complete BIM engineering project management consultancy documents.	Quanta BIM5D Platform
	Building Construction Measurement and Pricing Course Design	Implantation	Students will be able to perform BIM building calculation model construction to complete the construction project budget documentation for any given project.	Quanta BIM Civil Metrology Platform GTJ
	Measurement and Pricing of Installation Works Course Design	Implantation	Students will be able to perform BIM installation calculation model construction to complete the installation project budget documentation for any given project.	Quanta BIM Installation Metrology GQl

3. Building an ideological and political system for BIM-based courses

In order to ensure that higher education courses can achieve better development and ideological and political courses can be more effective, it is necessary to strengthen the ideological and political construction in professional cost engineering BIM-based courses and the establishment of the ideological and political system and operating mechanism; in addition, it is important to ensure that professional courses and ideological and political education are progressing in the same direction [5]. The BIM course system for cost engineering majors is also composed of four modules: professional foundation course, professional core course, industry-oriented course, and professional practical course. According to the different types of modules and teaching content, the ideological and political element integration path is explored to construct four progressive modules of curriculum ideology and politics.

3.1. Ideological and political elements embedded in BIM-based professional foundation courses

The professional foundation courses of academic disciplines refer to professional groups of the same professional class, reflecting the commonality of the professional class and the core compulsory foundation courses. The BIM-based professional foundation courses for cost engineering majors include "Introduction to Civil Engineering," "Civil Engineering Drawing," "Housing Architecture," and "BIM Modelling Application." These courses are usually offered in the second semester of freshman and sophomore years. The path of integrating curriculum ideology and politics relies on exploring the ideological and political elements in the foundation courses according to the characteristics and teaching contents, summarizing and refining them, as well as cultivating socialist values among students. Through this, students will be able to develop core socialist values, love for the country, understanding of traditional Chinese culture and national policies, engineering thinking, craftsmanship, humanism and national pride, as well as the spirit of self-improvement to pursue their dreams [6].

Using "Introduction to Civil Engineering (A)" as an example, we present the course orientation and teaching objectives as well as the key points of curriculum ideology and politics.

3.1.1. Course orientation and teaching objectives

"Introduction to Civil Engineering (A)" is a basic course for engineering and construction majors. This course takes the common types of civil engineering as the teaching subject and presents the whole picture of civil engineering to students in a general way, mainly elaborating the nature and characteristics of civil engineering, the history of development of civil engineering, the materials used in civil engineering, types of civil engineering, and its future development direction. Students must be familiar with the general contents of civil engineering as a discipline and the importance of civil engineering, so that they can fully understand the broad field of civil engineering, establish a professional mindset, gain a strong desire for knowledge and to pursue a career in civil engineering, as well as lay the foundation for subsequent professional courses.

3.1.2. Key points of curriculum ideology and politics

(i) Teaching the introductory course, along with the introduction to the major and the mega projects in the construction industry in recent years, students are guided to establish ambitious ideals and patriotism, correct world views, outlook on life, and values; bravely shoulder the glorious mission put forward by the times; and improve their ideological and political quality.

(ii) Using actual accidents as examples and speaking about various standard codes, teachers teach students to be compliant to the law and to develop good habits, professional ethical qualities, and a sense of safety and responsibility. In that way, students would develop a strong sense of responsibility and mission.

(iii) Through the study and understanding of civil engineering, students will be able to develop the "craftsmanship" spirit, including dedication, commitment, concentration, and innovation; a conscientious, responsible, practical, and dedicated work attitude; as well as a rigorous and meticulous work style. Moreover, they will learn to view and deal with problems with the idea of materialistic dialectics, practice correct thinking methods, develop scientific thinking habits, and think logically and dialectically.

3.2. Ideological and political elements embedded in BIM-based professional core courses

Professional core courses are courses that reflect the core knowledge, ability, and quality requirements of the profession. The cost engineering BIM-based professional core courses are mainly courses on construction technology, engineering costing software application, and BIM application and project management, which are usually offered in the first semester of sophomore and junior years. The path of integrating curriculum ideology and politics relies on the knowledge points and professional characteristics of the professional courses, the discovery of ideological and political elements in the professional courses, their summary and refinement, as well as the construction of the leading ideology of the course teaching. On the basis of Module 1, students will further develop awareness of engineering ethics and the rule of law, bottom-line thinking, dialectical thinking, double-creative thinking, integrated thinking, rigorous and meticulous thinking, as well as a sense of responsibility and contractual spirit.

Using "BIM Applications and Project Management (A)" as an example, we present the course orientation and teaching objectives as well as the key points of curriculum ideology and politics.

3.2.1. Course orientation and teaching objectives

"BIM Application and Project Management (A)" is a professional core course for cost engineering majors. Based on the whole process of engineering projects, this course provides a comprehensive and systematic study of the key aspects of engineering projects, including cost, schedule, quality, organization, and contract management, and applies BIM tools to the whole process of engineering project management. Through this

course, students will master the basic theoretical knowledge of engineering project management, establish a framework of professional knowledge and global awareness of project management, be able to apply advanced management methods and BIM to solve practical engineering problems, broaden their professional knowledge, improve their multidisciplinary literacy, establish a sense of teamwork, enhance their independent learning ability and communication and coordination skills, as well as lay the foundation for engagement in engineering project management and other related work upon graduation [7].

3.2.2. Key points of curriculum ideology and politics

(i) In terms of engineering project management practice, the idea is to enable students to understand the standards and specifications related to engineering project management, as well as to cultivate good professional ethics and a scientific and rigorous working attitude related to engineering project management among students.

(ii) The course content integrates multidisciplinary knowledge of management, economics, psychology, history, environmental art, *etc*., broadens students' subject knowledge and learning horizons, and develops students' literacy in aesthetics, history, literature, economics, and psychology with regard to project management.

(iii) Using social engineering cases for teaching, updating professional knowledge, and focusing on cultivating students' overall understanding and ability to analyze and deal with specific problems in engineering projects, knowledge from various disciplines and fields as well as new technical methods and means are applied.

3.3. Ideological and political elements embedded in BIM-based industry-oriented courses

Industry-oriented (professional direction) courses are restricted courses for majors and are centered on the concepts of individual student development and teaching according to students' ability. In each major, industry-oriented courses are set up according to the professional orientation and objectives of the major, as well as the needs of local economic and social development, so as to fully reflect the connotation of the major and the needs of the industry. BIM-based industry-oriented courses for cost engineering majors are courses on measurement and pricing of construction works, measurement and pricing of installation works, and measurement and pricing of municipal works. These courses are mainly offered in the first semester of junior and senior years. The path of integrating curriculum ideology and politics relies on on-campus practical training bases, teaching facilities, and comprehensive practical training courses. Through professional practical training, skills and discipline competitions, and the presentation of professional learning outcomes, ideological and political elements are integrated into industry-oriented courses and quality development activities. This enhances students' awareness of cost and social responsibility as well as promotes students' sustainable development, systemic thinking, and adherence to professional ethics [8].

Using "Measurement and Pricing of Construction Works" as an example, we present the course orientation and teaching objectives as well as the key points of curriculum ideology and politics.

3.3.1. Course orientation and teaching objectives

"Measurement and Pricing of Construction Works" is an industry-oriented (professional direction) course for cost engineering students. The course mainly focuses on engineering projects, drawing literacy, and the correct application of current national codes and current quotas for engineering project measurement and pricing activities. With the knowledge of civil engineering drawing, housing architecture, construction technology, and the principles of construction quotas, students will be able to understand the basic principles of construction work measurement and pricing, gain familiarity with the composition of bill of quantities and the rules for calculating the quantity of works, master the use of national specifications and

quotas for construction works, develop skills in preparing bill of quantities and engineering budgets, and gradually achieve professional growth in terms of rigorous specification, objectivity and impartiality, as well as the mindset to strive for excellence.

3.3.2. Key points of curriculum ideology and politics

(i) Through theoretical learning and skills practice in measurement and pricing, students will be equipped with scientific and rigorous thinking when calculating construction quantities, strictly implement national norms, without falsification of pricing, develop excellent professionalism, adhere to professional ethics, and gain awareness of job responsibilities [9].

(ii) In terms of subject expertise and professional practical skills, the professional knowledge points and contents of engineering project costing are constantly updated to meet the needs of industrial digitalization, industrialization, and intelligence. Through practical cases, students will analyze the impact of cost control and cost management on the parties involved in engineering projects and develop a sense of professional identity and social responsibility.

(iii) Students are encouraged to ask questions or inquire in the learning process, using inspirational, case-based, and question-based approaches. Through all these, students' learning initiative and self-learning ability will improve, and they will grow into well-rounded talents in their field of study.

3.4. Ideological and political elements embedded in BIM-based professional practical courses

The goal of professional practical courses is to cultivate students' scientific literacy and academic standards, knowledge application and hands-on skills, design ability, investigation and analytical skills, decision-making and consultation skills, creativity, as well as organization and management skills. The BIM-based professional practical courses for cost engineering majors include "BIM Application and Project Management Course Design," "Construction Engineering Measurement and Pricing Course Design," and "Installation Engineering Measurement and Pricing Course Design." These courses are offered in sophomore, junior, and senior years, across 17–18 weeks. Students are required to simulate actual work scenarios on the basis of learning the theoretical aspect. The path of integrating curriculum ideology and politics is through the completion of specific work tasks, hands-on practice and training, gaining real-life practical experience, appreciating the great changes in the economy and society brought by the reform and opening up, the cultivation of professionalism, professional ethics, honesty, and trustworthiness, along with internet thinking, cross-border integration, and collaborative thinking, as well as the development of lifelong learning habits, social responsibility, and commitment [10].

Using "BIM Applications and Project Management" as an example, we present the course orientation and teaching objectives as well as the key points of curriculum ideology and politics.

3.4.1. Course orientation and teaching objectives

"BIM Applications and Project Management" is a course that embodies comprehensive training based on students' theoretical knowledge of project management. Based on the application of BIM in all stages of project management, including BIM model establishment, design plan optimization, construction management organization structure optimization, project scheduling, cost analysis, construction quality monitoring, and construction plan simulation display, the course takes housing architecture drawing and engineering information as the basis to apply BIM to actual engineering project management. In that way, students will be able to prepare complete BIM-based engineering project management consultancy documents.

3.4.2. Key points of curriculum ideology and politics

In this course, students will be able to deepen their theoretical understanding of previous professional courses by completing various BIM-based engineering project management consultancy documents, which would also help students gain global awareness of project management and establish professional knowledge framework, equip them with skills to solve practical engineering project management problems by using BIM, create better teamwork spirit among students, and enhance their communication and coordination skills.

4. Conclusion

The vigorous promotion of BIM has brought about challenges and opportunities to cost engineering majors. In order to cultivate "BIM + cost engineering" composite talents, various teaching reforms are still being explored. In this paper, we study the reform of the BIM curriculum system, analyze the key points of curriculum ideology and politics in cost engineering majors, and discuss the optimization of the four modules (professional foundation course, professional core course, industry-oriented course, and professional practical course), so as to build a suitable BIM curriculum system embedded with ideological and political elements for applied undergraduates.

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Application Research of Medical Imaging Practical Teaching Based on Virtual Simulation Teaching Platform

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Abstract: *Objective:* To explore the application effect of virtual simulation teaching platform in the practical teaching of medical imaging. *Methods:* A total of 97 students majoring in medical imaging technology of class 2022 were selected and divided into two groups according to the random number method: control group (n = 48) and observation group (n = 49). The observation group was under the practical teaching mode based on the virtual simulation teaching platform, while the control group was under the traditional multimedia teaching mode. Questionnaire survey and teaching assessment were carried out after the teaching period, and the application effects of the two teaching modes were compared. *Results:* The reading and theoretical scores of the students in the observation group were significantly higher than those of the students in the control group ($P < 0.01$); there were statistically significant differences in the results of the questionnaire survey (improved learning interest, improved language expression, improved ability to comprehensively analyze problems, and improved teamwork awareness) between the two groups of students ($P < 0.05$); the students in the observation group were markedly more satisfied with the teaching content, teaching methods, and teaching quality than the students in the control group ($P < 0.05$). *Conclusion:* The medical imaging practical teaching mode based on virtual simulation platform not only helps improve students' theoretical understanding and practical ability in medical imaging technology, but also improves students' learning interest, language expression ability, ability to comprehensively analyze problems, communication skills, teamwork awareness, and satisfaction with the teaching content, teaching methods, and teaching quality. Therefore, it has wide application value in medical specialty education.

Keywords: Medical imaging; Virtual simulation; Practical teaching; Problem-oriented

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1. Introduction

As one of the fastest-growing and most widely-involved disciplines in the field of modern medicine, medical imaging has become a discipline with strong practical requirements with the continuous development. In recent years, with the rapid development of medical imaging technology, the clinical demand for medical imaging talents is also increasing [1]. However, due to the complexity involved in medical imaging technologies, such as computed tomography (CT), magnetic resonance imaging (MRI), and positron emission tomography (PET)-CT, many of the content requires learning through practice, and the speed at which new information is updated results in a shortage of clinical talents. However, there are some disadvantages in traditional medical imaging practical teaching methods, which have led to the failure

of trained medical imaging talents in meeting the skill requirements of clinical imaging diagnosis and treatment. For this reason, many colleges and universities have begun to make efforts to improve the traditional practical teaching mode through virtual simulation technology. The so-called virtual simulation technology is a technology that involves the use of computer technology to establish a virtual space to simulate various scenes and experimental objects [2]. At present, the virtual simulation technologies used in medical imaging include medical imaging virtual simulation platform, simulated surgery system, and virtual CT/MR. Among them, the medical imaging virtual simulation platform primarily functions to simulate various types of medical imaging images and functions through computers, allowing students to simulate clinical examination operations without being in contact with actual clinical situations, and thus helping students gain understanding of the components of medical imaging. At the same time, the virtual simulation teaching platform also enables students to realize automation and intelligence in pre-class preview, in-class learning, and after-class review, thus further assisting students in mastering medical imaging knowledge and improving students' learning efficiency. In the present study, we examined the application of the virtual simulation teaching platform in the practical teaching of medical imaging through a clinical trial.

2. Materials and methods

2.1. General information

A total of 97 students majoring in medical imaging technology of class 2022 were selected and divided into two groups according to the random number method: control group (48 cases), which adopted the traditional multimedia teaching method, and observation group (49 cases), which adopted the clinical case-oriented virtual simulation teaching platform practical teaching method. In the control group, there were 23 male and 25 female students, with a mean age of 22.65 ± 2.27; in the observation group, there were 25 male and 24 female students, with a mean age of 23.02 ± 1.95. The differences in the enrollment scores, teachers, and baseline data of the students were not statistically significant ($P > 0.05$); thus, the two groups of students were comparable.

2.2. Methods

The control group adopted the traditional multimedia teaching method, and the teaching duration was 8 weeks. Traditional PowerPoint (PPT) teaching was implemented in all medical imaging theory courses, and the teaching plan was uniformly formulated by the teaching and research department, with the key and difficult points clearly indicated. After the theoretical course, practical observation teaching was carried out by placing a teaching film over a lighted screen for students to inspect; the teacher would explain it, and the students would then read the film in groups.

The observation group adopted the clinical case-oriented virtual simulation teaching platform practical teaching mode; similarly, the teaching duration was 8 weeks.

(1) Building a virtual simulation teaching platform for medical imaging. The Medical Imaging Training Center network resource sharing platform was developed in cooperation with Chongqing Huajiao Technology Co., Ltd. and participated in the use of simulation software. Three-dimensional (3D) simulation technology, multimedia, human-computer interaction technology, network technology, *etc*., were used, and a virtual simulation practice project based on medical imaging diagnosis and treatment thinking and standard operating procedures was built to train imaging technology capabilities, as well as conduct teaching and training in 3D interactive ways and assessment. The platform mainly includes two modules: teaching resources and teaching management. The former includes teaching videos of imaging technology, summaries of important and difficult theoretical knowledge, *etc*., while the latter focuses on the maintenance of the virtual simulation platform by teachers, the monitoring and management of data

statistics, and student feedback. See **Figure 1** for the structural diagram of the virtual simulation online platform.

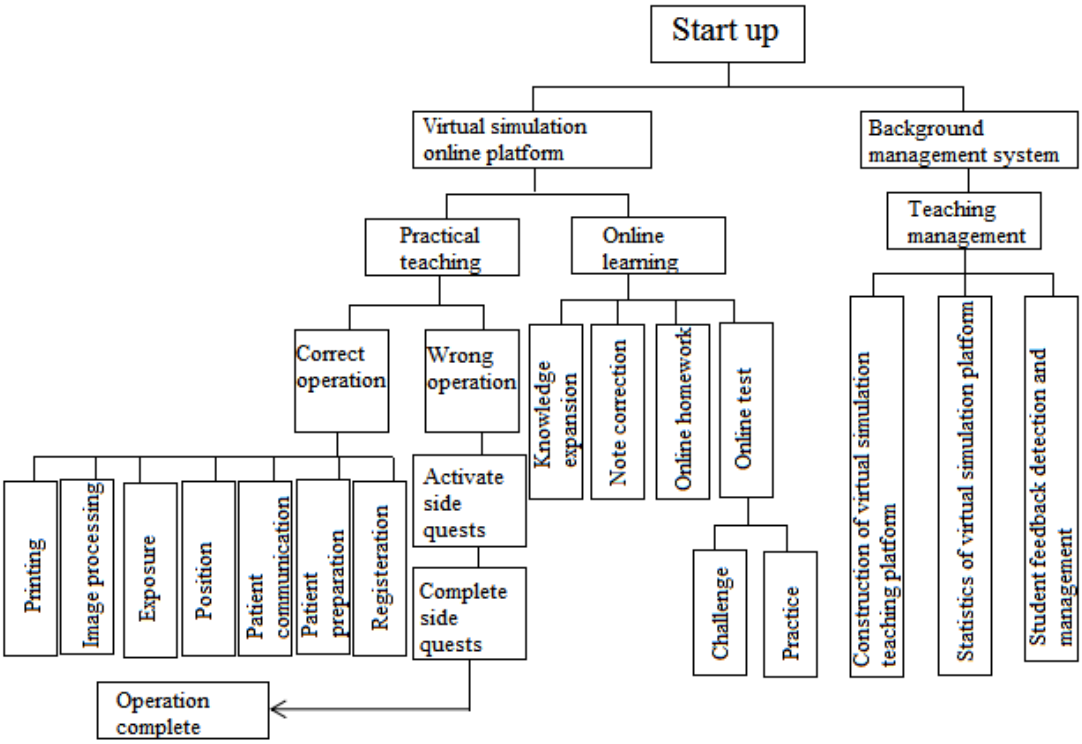

Figure 1. Structural diagram of the virtual simulation teaching platform

(2) Creating a digital network image teaching mode. On the virtual simulation teaching platform, contents related to general radiology, as well as CT and MRI, are presented, including modules such as imaging case database, imaging picture database, new imaging technology frontier, student information database, *etc*., creating a new digital network imaging teaching mode. Teachers can select appropriate clinical cases and integrate anatomy, pathology, diagnostics, and other content into the virtual simulation process, so that students would be able to link their knowledge of medical imaging with other disciplines, allow them to experience the process of disease development and diagnosis, gradually cultivate their clinical thinking, deepen their understanding of medical imaging, and improve their independent learning ability.

(3) Online learning of medical imaging theory. Through the virtual simulation online platform, online teaching of medical imaging can help students deepen their understanding of key and difficult points. We used a large number of microscopic models and 3D animations to vividly demonstrate relevant knowledge points, such as MRI imaging principles, including magnetic and nonmagnetic nuclei, nuclear spin, precession, resonance, relaxation, and imaging cross-section analysis. Macro and micro demonstration animations, along with concrete and abstract intelligent voice explanations would help students understand the mathematical model behind the phenomenon and the significance of imaging; in addition, students can also click on the model to adjust the viewing angle, modify the experimental conditions, and obtain the corresponding feedback results. Through virtual practice, they can verify the principles, strengthen their understanding of knowledge points, achieve inferences from one instance, and establish a systematic knowledge framework of imaging. The students were also assigned homework and allowed to conduct self-inspection and error correction in the process of completing their homework online. This process deepens their understanding of knowledge points. On the virtual simulation education platform, the students could do exercises, challenges, *etc*. Upon understanding the most basic

imaging knowledge, students can carry out extended learning according to their own schedule. Through online tests, teachers will learn about students' weak points, thus giving them timely opportunity to adjust their teaching plans and optimize the teaching content.

(4) Virtual simulation practice operation. After the students have mastered the basic theory of imaging technology, they can complete the corresponding X-ray/CT/MRI principle virtual simulation experimental learning through the online virtual simulation platform, complete the imaging inspection of the virtual patient, fully understand the content of each link (registration – patient preparation – patient communication – positioning – exposure – image processing – printing), and think deeply about the imaging principles and detection technology, thus realizing the teaching goal of combining theoretical knowledge and practice.

2.3. Observation indicators

(1) After the 8-week teaching period, the two groups of students were tested on their learning outcomes. The theoretical knowledge assessment included knowledge of X-ray/CT/MRI principles, equipment performance, detection methods, inspection safety, and image characteristics, while the practical skill assessment included film reading, with a full score of 100 points.

(2) Questionnaires were used to investigate students' cognition of the teaching mode, including the role in improving learning interest, improving language expression, improving the ability to comprehensively analyze problems, and improving teamwork awareness, as well as their satisfaction with the teaching content, teaching methods, and teaching quality of medical imaging.

2.4. Statistical analysis

Statistical software SPSS 22.0 was used for data analysis; measurement data were expressed as mean ± standard deviation, and *t*-test was performed for comparison between groups; count data were expressed as n (%), and chi-square (χ^2) test was performed; $P < 0.05$ indicates statistically significant difference.

3. Results

3.1. Final grades

The students in the observation group scored 83.3 ± 4.8 and 86.2 ± 3.6 points in film reading and imaging theory, respectively. Both of the scores were significantly higher than those of the control group (72.5 ± 3.2 and 73.6 ± 5.4; $P < 0.01$), as shown in **Table 1**.

Table 1. Comparison of final grades between the two groups of students

Group	Number of students	Score	
		Film reading	Imaging theory
Control group	48	72.5 ± 3.2	73.6 ± 5.4
Observation group	49	83.3 ± 4.8	86.2 ± 3.6
t		13.0108	13.5474
P		0.0000	0.0000

3.2. Questionnaire survey results

There were statistically significant differences in the results of the questionnaire survey (improved learning interest, improved language expression, improved ability to comprehensively analyze problems, improved communication skills, and improved teamwork awareness) between the two groups of students ($P < 0.05$). See **Table 2** for details.

Table 2. Analysis of questionnaire survey results

Group	Number of students	Improved interest in learning	Improved language expression	Improved ability to comprehensively analyze problems	Improved teamwork awareness
Control group	48	26 (54.16)	25 (52.08)	23 (47.92)	19 (39.58)
Observation group	49	45 (91.83)	43 (87.75)	42 (85.71)	44 (89.79)
χ^2		17.5376	14.7215	15.6702	26.8544
P		0.0000	0.0001	0.0001	0.0000

3.3. Teaching satisfaction

Comparing the satisfaction of students with the teaching content, teaching methods, and teaching quality between the two groups, the students in the observation group showed significantly higher satisfaction with all three indicators than those in the control group ($P < 0.05$). See **Table 3** for details.

Table 3. Comparison of teaching satisfaction between the two groups of students

Group	Number of students	Teaching content	Teaching method	Teaching quality
Control group	48	30 (62.50)	29 (60.42)	31 (64.58)
Observation group	49	46 (93.84)	45 (91.83)	45 (91.83)
χ^2		14.0739	13.2332	10.6174
P		0.0002	0.0003	0.0011

4. Discussion

With the advancements in modern medicine, imaging has become one of the important means of clinical diagnosis. In view of its low cost and reusability, it is widely used in clinical examination. However, due to its complexity and involvement of various types of equipment, the operators are required to have good hands-on skills [3]. In the cultivation of imaging professionals, problems such as low teaching efficiency and poor teaching effect exist in the traditional teaching mode. These problems have become the key factors that restrict the improvement of medical imaging teaching quality. In order to solve the problems existing in the current teaching of medical imaging, researchers have put forward training plans and curriculum standards for medical imaging professionals as well as student-centered and problem-oriented virtual simulations of medical imaging practical teaching by using modern information technology platform. This platform integrates and optimizes the instruments and equipment involved in image inspection, adopts a modular management method, and realizes the basic operations of various instruments and equipment, typical images of typical diseases, and teaching interaction [4]. This student-centered platform satisfies three learning methods: independent learning, cooperative learning, and inquiry learning. Along with a mixed teaching mode that combines online and offline teaching methods, the platform realizes the application of multimedia technology and virtual simulation technology to medical imaging. By carrying out the reform of the multi-disciplinary cross-integration compound talent training mode, the limitation of time and space is broken, and learning activities can be carried out anywhere that has a network. This greatly improves the enthusiasm of students to participate in learning activities, thereby achieving the goal of improving the practical and innovation skills of medical imaging students. In addition, the platform also includes imaging technology experiment course design, typical case reports, imaging technology assessment, medical imaging evaluation system, and other functions [5]. By completing the above modules, students would be able to test and consolidate the knowledge and skills they have learned.

In this study, by comparing the learning effects of students in the control group under the traditional multimedia teaching mode and the observation group under the practical teaching mode based on the clinical case-oriented virtual simulation teaching platform, we found that the students in the observation group scored significantly higher in film reading and imaging theory than those in the control group ($P < 0.01$); in addition, the questionnaire survey results (improved learning interest, improved language expression, improved ability to comprehensively analyze problems, and improved teamwork awareness) were better in the observation group compared to the control group ($P < 0.05$); and the satisfaction of students with the teaching content, teaching methods, and teaching quality was significantly higher in the observation group than in the control group ($P < 0.05$).

5. Conclusion

The application of clinical case-oriented virtual simulation teaching platform practical teaching in the teaching practice of medical imaging professional courses can significantly improve students' ability to master the theoretical understanding and hands-on skills of medical imaging; in addition, it is beneficial to improving students' learning interest, language expression, ability to comprehensively analyze problems, and teamwork awareness. Given its positive role, this teaching mode is worthy of extensive application in medical specialty education.

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Disclosure statement

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Design and Analysis of Civics Education in the Course "Measurement and Pricing of Installation Works"

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Abstract: In order to implement moral education, ideological and political work must be carried out throughout the whole process of education and teaching. Taking the course "Measurement and Pricing of Installation Works" as the subject and professional knowledge and skills as the carrier, we explored the elements of ideological and political education contained in this course as well as the value of ideological and political education to this course, in order to realize the teaching goal of "trinity," which includes value shaping, knowledge transfer, and skill cultivation.

Keywords: Elements of ideological and political education; Trinity

Online publication: May 29, 2023

1. Introduction

The combination of professional courses and "Curriculum Civics" in higher vocational institutions has become an essential part of education development in the new era. The teaching concept of "Curriculum Civics" includes the integration of ideological and political education into all aspects of curriculum teaching and reform, so as to realize the three-pronged education [1]. The ideology and politics of professional courses should emphasize on the teaching practice of professional courses, the cohesion of knowledge in the dissemination of value, and the value leadership in the dissemination of knowledge [2]. The ideology and value leadership are integrated into the curriculum standards, lecture plans, teaching contents, and evaluation. We focus on cultivating students' truthfulness, pragmatism, practical innovation, excellence, rigor and conscientiousness, hard work, and pursuit of excellence, so that they can grow into professionals who care about the society and carry the responsibility of the times.

2. Design and implementation of civics education in the course "Measurement and Pricing of Installation Works"

"Measurement and Pricing of Installation Works" is not only a professional core course for senior students in cost engineering, but also a technical, economic, and comprehensive compulsory course. The course includes a wide range of subjects (including electrical, water supply and drainage, fire protection, ventilation and air conditioning, heating, *etc.*), the reading of architectural drawings, and equipment installation as a professional basis, while focusing on determining the amount of installation work by calculation and reasonable pricing.

2.1. Teaching objectives

Combining the professional standards of the Ministry of Education, enterprise certification, and the talent training program formulated by our school, the curriculum standard of "Measurement and Pricing of Installation Works," and the professional requirements of the school to design the teaching contents, the knowledge objectives, competency objectives, quality objectives, and civic objectives are formulated, as shown in **Table 1**.

Table 1. Teaching objectives

Knowledge objectives	(i) To master the basic knowledge of installation project cost and the method of reading drawings. (ii) To master the rules in calculating the quantity of installation works and relevant cost provisions. (iii) To master knowledge related to the specification of bill of quantities for installation works, and to master the principle and steps of preparation for the installation project budget.
Competency objectives	(i) To be able to read conventional construction drawings. (ii) To be able to apply the correct list quota subheadings according to the construction techniques of installation works. (iii) To be able to account for the volume of work according to the measurement method of the list of each specialty of installation works. (iv) To be able to use software to complete modeling, measurement and pricing, and other related work.
Quality objectives	(i) To cultivate a meticulous-and-patient working style among students. (ii) To cultivate students with planning, organizing, and coordinating skills. (iii) To cultivate students' sense of teamwork and improve their interpersonal communication skills. (iv) To exercise students' logical thinking skills and hands-on skills.
Civic objectives	(i) To cultivate an independent, rigorous, and factual working style as well as team consciousness among students; to cultivate the spirit of continuous innovation and good professional ethics in students. (ii) To cultivate students' "craftsmanship" and socialist core values (patriotism, dedication, integrity, and friendliness).

2.2. Conception of civics education

By digging deeper into the elements of ideological and political education contained in this course and the ideological and political education functions of this course and taking professional knowledge and skills as the carrier, it is possible to achieve the teaching goal of "trinity" (value shaping, knowledge transfer, and skill cultivation). The specific design plan is shown in **Table 2**.

Table 2. Design plan of "Curriculum Civics"

Key knowledge points	Civics material	Civics element	Expected results
Project 1: Overview of installation project costing			
(i) Division and composition of construction and installation work cost. (ii) Calculation method of construction and installation work cost.	(i) Sharing of successful projects to improve competitiveness in the infrastructure sector by focusing on budgeting in all phases of the project.	(i) Cultivate students' rigor and meticulousness as well as engineering consciousness in applying what they have learned.	(i) Inspire students' patriotic enthusiasm and national self-confidence. (ii) Enhance awareness of security.

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Key knowledge points	Civics material	Civics element	Expected results
	(ii) Safety and civilization construction costs as non-competitive costs reflecting safety and environmental protection. (iii) Introduction of projects exceeding budget cases. (iv) Real-time update of cost information.	(ii) Cultivate students' patriotic spirit and national self-confidence. (iii) Cultivate the spirit of "learning to keep up with the times."	
Project 2: Measurement and pricing of water supply and drainage projects			
(i) Reading of construction drawings of water supply and drainage works. (ii) Calculation of quantity of water supply and drainage works, and preparation of bill of quantities. (iii) Preparation of pricing documents for water supply and drainage projects.	(i) Large price differences for pipes of different diameters. (ii) Case study of huge losses due to calculation errors. (iii) Specification for calculation of Quantity of General Installation Works GB50856-2013. (iv) Chongqing General Installation Project Pricing Quotas (2018 Edition).	(i) Cultivate standardized, rigorous, and meticulous professionalism among students; as well as the engineering consciousness and innovative spirit of what they have learned. (ii) Develop students' awareness of national standards and norms.	(i) Increase students' motivation to learn. (ii) Enhance the teaching effect.
Project 3: Construction electrical engineering measurement and pricing			
(i) Reading of construction drawings of construction electrical works. (ii) Calculation of quantities of construction electrical works and preparation of bill of quantities. (iii) Preparation of construction electrical engineering billing documents.	(i) Safety hazards caused by jerry-built materials. (ii) Case study of huge losses due to calculation errors.	(i) Train students to work in a safe, disciplined, and meticulous manner. (ii) Develop standardized calculation and a rigorous, meticulous, and factual working style.	(i) Enhance students' learning motivation. (ii) Improve students' independent learning ability. (iii) Enhance the teaching effect.
Project 4: Construction fire engineering measurement and pricing			
(i) Reading of construction drawings of construction fire engineering.	(i) Analysis of fire safety accident cases.	(i) Cultivate standardized, rigorous, and meticulous professionalism among students;	(i) Enhance students' independent learning ability. (ii) Improve students' keen career sense.

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Key knowledge points	Civics material	Civics element	Expected results
(ii) Calculation of quantities and preparation of bill of quantities for construction fire protection works. (iii) Preparation of construction fire engineering billing documents.	(ii) Relevant initiatives taken by the state to attach importance to fire-fighting work. (iii) Case study of huge losses due to calculation errors.	as well as the engineering consciousness and innovative spirit of what they have learned. (ii) Cultivate students' patriotic spirit and national self-confidence.	
Project 5: Ventilation and air-conditioning project measurement and billing			
(i) Reading of construction drawings of ventilation and air-conditioning works. (ii) Calculation of the quantity of ventilation and air-conditioning works, and preparation of bill of quantities. (iii) Ventilation and air-conditioning project billing documents preparation.	(i) Analyze the impact of the epidemic on the HVAC industry and its future development direction. (ii) Case study of huge losses due to calculation errors.	(i) Cultivate a sense of norms, love for work, professionalism, and solidarity. (ii) Cultivate scientific thinking methods and a sense of responsibility and mission to explore the unknown.	(i) Motivate students to explore knowledge. (ii) Exercise students' ability to think about problems, analyze them, and solve them.
Project 6: Installation of costing software applications			
(i) Master the basic ideas of software calculation for each construction and installation work. (ii) Able to use software to model, export the complete bill of quantities, and complete the preparation of billing documents.	(i) Introduction to the development and application of software for measurement and pricing of installation works. (ii) Case study of consequences resulting from computer viruses, reminding students to download software from the official website.	(i) To develop legal and normative awareness. (ii) Cultivate rigorous and meticulous professionalism. (iii) Look at problems with a development perspective.	(i) Enhance students' motivation to learn. (ii) Improve students' rigorous and meticulous professionalism. (iii) Enhance students' sense of identity and self-confidence in subject knowledge.

Abbreviations: HVAC, heating, ventilation, and air conditioning

2.3. Implementation of civics education

The course is taught in a flipped classroom, with task-driven and hands-on exercises.

In the "Overview of Installation Project Costing" module, which is issued before introductory tasks, students are required to review representative works in the field of infrastructure, report and discuss in small groups in class, demonstrate the characteristics of each building, and compare the budget indicators of each

stage. In order to eliminate the vicious competition of enterprises in abandoning the safety and security costs of construction personnel and environmental protection measures, the state has stipulated the safety and civilization construction fee as a non-competitive fee for bidding. This reflects the country's effort toward people-oriented production concept and determination to protect the environment [3]; the cultivation of students' rigorous and meticulous professionalism as well as engineering consciousness in applying what they have learned; the cultivation of students' patriotic spirit and national self-confidence; and the cultivation of students' awareness of safety and confidentiality.

In the measurement and pricing modules for each installation, engineering case drawings are released before class, and students are required to read the drawings and go through the online open course. Students are supposed to operate in groups during class and compare the results obtained; with any inconsistent result, they must look for the reasons for the inconsistency and make appropriate corrections. Teachers will then discuss certain problems in cost engineering by introducing cases, especially on incompatible units, misplaced decimal points, and inaccurate dimensional measurements.

In the "Installation of Costing Software Applications" module, engineering tasks are issued, projects are completed in groups, and engineering cases are used as a carrier to master knowledge points in the process of analyzing problems, cultivate legal and normative awareness, as well as cultivate rigorous and meticulous professionalism.

2.4. Teaching reflection

(i) Implementation effect and results

In order to investigate the effect of civics education in "Measurement and Pricing of Installation Works," a survey questionnaire was carried out at the end of the semester. A total of 80 questionnaires were distributed, and 75 copies were collected; the recovery rate was 93.75%. The results of the survey showed that the students were positive about the effectiveness of civics education in "Measurement and Pricing of Installation Works."

(ii) Problems

Some students are reluctant to invest more time and effort outside class, and large gaps exist in the completion of tasks issued by the teacher, with varying degrees of mastery.

(iii) Improvement measures

Explore deeper connotations, break down tasks more interestingly, and stimulate students' interest in learning. Increase supervision and control before and after class to jointly improve teaching effectiveness.

3. Value of civics education in "Measurement and Pricing of Installation Works"

(i) Promote socialist core values and cultivate good professional conduct

Through the development of the construction industry, cutting-edge technology, and China's construction projects from ancient times to the present epidemic, the use of teaching examples related to construction quality and price control helps strengthen students' sense of professional ethics and establish a sense of social responsibility and professional reverence in their hearts.

With regard to engineering cost activities throughout the various aspects of capital construction activities (feasibility study, design, construction, completion, and acceptance), the calculated project cost not only determines the economic benefits of micro-engineering subjects, but also governs the investment efficiency of funds and social benefits of the project. In the process of practice, cost engineering personnel must not only have excellent professional knowledge and dedication to the work style, but also have a broad mind for their own work, their own micro-economic subjects, and their own country to ensure responsible cost engineering data.

(ii) Promote the spirit of excellence

With economic development and social progress, enterprises need down-to-earth, hardworking, and meticulous talents with professional skills and excellence who pursue the spirit of excellence. For cost engineering personnel, strict work ideas and meticulous calculations are the embodiment of the spirit of excellence, as each digit after a decimal point may greatly affect the economy or quality.

(iii) Cultivate the innovative spirit of keeping up with the times and pursuing excellence

Guided by the thought of socialism with Chinese characteristics in the new era, we need to ensure that theoretical knowledge is taught well and there is proper guidance of values. We must also proactively pay attention to architectural innovation and understand the dynamics of Building Information Modeling (BIM), assembly building, and other forewords to keep up with the times and pursue excellence.

4. Conclusion

The course "Measurement and Pricing of Installation Works" contains rich elements of curriculum ideology and politics, which must be constantly thought of and extended. The reform of curriculum ideology and teaching is time-sensitive, and the integration point of curriculum ideology and politics is constantly changing with societal development. Therefore, we need to constantly pay attention to the new developments in the industry, brainstorm, and upgrade the industry.

Disclosure statement

The authors declare no conflict of interest.

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Revision of "Introduction to General Medicine" Based on the Six-Step Curriculum Development Process

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Abstract: *Objective:* Based on the six-step curriculum development process proposed by Professor Schneiderhan *et al*., the course needs, the cognition, and course summative assessment results, combined with the career preferences and work value orientation of clinical medical students undertaking the course "Introduction to General Medicine" were surveyed. *Methods:* A self-designed questionnaire was used to collect information on the course cognition, course summative evaluation, and professional inclination of 233 junior medical students majoring in clinical medicine undertaking the course "Introduction to General Practice." An analysis was conducted to provide a basis for curriculum revision in accordance with the structured composition of the curriculum development process. *Results:* (i) In terms of course cognition, before the course, 67.0% of students were unaware of general medicine and general practitioners, 73.0% of students had never participated in practical activities (including volunteer work), and 53.6% of students expressed interest in the course; there were significant differences in the growth environment, the frequency of participation in club activities, the cognition of general medicine/general practitioners before the course, participation in practical activities (including volunteer work), attentiveness to the current situation of medical treatment, and the interest toward the course ($P < 0.05$); multi-factor logistics analysis showed that the factors influencing the interest toward the course include growth environment, frequency of participation in club activities, course cognition, participation in practical activities, and attentiveness to the current status of development of medical treatment. (ii) The course summative assessment results showed that 91.8% of students felt that it is necessary to learn this course, 33.9% of students felt that the most important thing in the course is to learn the theoretical knowledge of general medicine and related diagnosis and treatment skills, 53.2% of students felt that the most unfavorable factor affecting the learning of this course is the lack of interest in general medicine, and 64.4% of students hoped for more clinical practice to understand and participate in the work of general practitioners; paired *t*-test revealed differences in career preferences before and after the course ($P < 0.05$); after the course, more students thought that general practitioner is an ideal career option. (iii) The results showed that 58.8% of students had considered their future specialty but did not have specific goals or plans, while 21.9% had considered their future specialty and had clear goals; there was a significant difference in professional inclination between genders as well as those who were attentive to the current state and development of medical treatment in our country and those who were not ($P < 0.05$); with regard to the scores of importance in terms of the influencing factors of professional inclination, interest and possibility of professional development scored 3.92, ranking first, followed by income, which scored 3.91, and career prestige, which scored the lowest (3.62). *Conclusion:* Based on the needs assessment of clinical medical students, it is important to focus on improving students' interest in general medicine, especially their cognition and professional understanding of the course before the course itself, in addition to the development of relevant practical activities, and their attentiveness to the current state and development of medical treatment. The summative assessment results suggest that the implementation of this course has a positive influence on the career preferences of clinical medical students to a

certain extent. Therefore, it is necessary to combine the course content with the development of general medicine, so as to stimulate students' interest in self-driven learning and in general medicine. This will attract more students whose work value orientation is influenced by interest and possibility of professional development to choose general practitioner as their future professional inclination.

Keywords: General practice; Undergraduate medical education; Course

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1. Introduction

At present, the field of general practice in undergraduate medical education is faced with two challenges: (i) how to improve the appeal of general medicine to medical students? and (ii) how to further cultivate and contribute more qualified general practitioners to primary medical care? Therefore, "Introduction to General Medicine" plays a key role as an important course in undergraduate medical education. This paper is based on the six-step curriculum development process proposed by Professor Schneiderhan *et al.* [1], which includes needs assessment, content determination, goal and objective statement, education strategy selection, curriculum implementation, and curriculum evaluation. An investigation of medical students undertaking the course "Introduction to General Practice" was carried out to analyze the course needs, cognitive status, and course summative evaluation results, combined with their professional inclination and work value orientation, for curriculum revision.

2. Data and methods

2.1. Participants

Junior medical students majoring in clinical medicine undertaking the course "Introduction to General Practice" from March to June 2021.

2.2. Research methods

An online questionnaire was designed by referring to existing literature on the network platform, and survey data on course cognition, course summative assessment, and professional inclination of junior medical students undertaking the course were collected. A total of 246 questionnaires were distributed, and 233 were collected; the response rate was 94.7%.

2.3. Statistical analysis

SPSS 22.0 was used to establish the database and input data, and relevant statistical analyses were carried out. Chi-square test and paired *t*-test were used for statistical analysis, and logistics regression was used for multi-factor analysis. The significance level was set to 0.05. The importance of relevant influencing factors on the professional inclination of students was scored on a 5-point scale (1 = not important; 5 = very important), and the average value was taken.

3. Results

3.1. Sociodemographic characteristics

Among the 233 junior medical students majoring in clinical medicine, 84 (36.1%) were male and 149 (63.9%) were female; two (0.9%) of them were 18 years old, three (1.3%) were 19, 53 (22.7%) were 20, 126 (54.1%) were 21, 37 (15.9%) were 22, 11 (4.7%) were 23, and one (0.4%) was 24 years old; 83 (35.6%) had family members or friends practicing as medical specialists (64.4%), while 150 (64.4%) did not; 45 (19.3%) had family members or friends practicing as general practitioners (or primary health care), while 188 (80.7%) did not; in terms of their growth environment, 52 (22.3%) were brought up in urban areas, 82

(35.2%) in town areas, and 99 (42.5%) in rural areas; in terms of the frequency of participation in club activities, 20 students (8.6%) often participated, 94 (40.3%) participated sometimes, 99 students (42.5%) participated occasionally, and 20 (8.6%) had never participated; in terms of the students' attentiveness to our country's status quo of medical development, 183 (78.5%) were attentive, while 50 (21.5%) were not.

3.2. Course cognition

Before the course, 67.0% of students did not know about general medicine and general practitioners, 73.0% had never participated in practical activites (including volunteer work), and 53.6% expressed interest in the course. There were statistically significant differences in the students' interest in the course among different growth environments, frequency of participation in club activities, knowledge of general practice/general practitioner before the course, participation in general practice activities (including volunteer work), and attentiveness to the current state and development of medical treatment ($P < 0.05$). Students who grew up in town and rural areas showed more interest in the course than urban students; students who often or sometimes participated in club activities showed more interest in the course than those who occasionally or had never participated; students who knew about general practice and general practitioners before the course showed more interest in the course than those who did not; students who participated in practical activities (including volunteer work) were more interested in the course than those who did not; students who were attentive to the current state and development of medical treatment in our country were more interested in the course than those who were not (see **Table 1**).

Table 1. Comparison of the level of interest in "Introduction to General Practice" among clinical medical students with different characteristics

Type	Number	Degree of example (n,%)		χ^2	*P*
		Interested	Not interested		
Growth environment					
Urban area	52	17 (32.7)	35 (67.3)	11.924	0.003
Town area	82	50 (61.0)	32 (39.0)		
Rural area	99	58 (58.6)	41 (41.4)		
Frequency of participation in club activities					
Often	20	14 (70.0)	6 (30.0)		
Sometimes	94	58 (61.7)	36 (38.3)	12.265	0.007
Occasionally	99	48 (48.5)	51 (51.5)		
Never	20	5 (25.0)	15 (75.0)		
Knowledge of general practice/ general practitioners before the course				19.205	0.000
Yes	77	57 (74.0)	20 (26.0)		
No	156	68 (43.6)	88 (56.4)		
Participated in practical activities (including volunteer work)				17.645	0.000
Yes	63	48 (76.2)	15 (23.8)		
No	170	68 (45.3)	88 (54.7)		
Attentive to the current state and development of medical treatment in our country				16.841	0.000
Yes	183	111 (60.7)	72 (39.3)		
No	50	14 (28.0)	36 (72.0)		

A multi-factor logistics regression analysis on the interest of students in the course was conducted, with the inclusion of the above factors. The values are shown in **Table 2**.

Table 2. Variable assignment used in logistics regression

Variable	Definition	Scale
Degree of interest	0 = No; 1 = Yes	Classification scale
Growth environment	1 = Urban area 2 = Town area 3 = Rural area	Classification scale
Frequency of participation in club activities	1 = Often 2 = Sometimes 3 = Occasionally 4 = Never	Classification scale
Knowledge of general practice/general practitioners before the course	1 = Yes 2 = No	Classification scale
Participated in practical activities (including volunteer work)	1 = Yes 2 = No	Classification scale
Attentive to our country's current state and development of medical treatment	1 = Yes 2 = No	Classification scale

The results are shown in **Table 3**. The factors influencing the degree of interest in the course include the growth environment, frequency of participation in club activities, course cognition, participation in practical activities (including volunteer work), and attentiveness to the current state and development of medical treatment.

Table 3. Logistic regression of clinical medical students' interest in "Introduction to General Practice"

Variable	B	SE	Wald	*P*	OR	95% CI
Growth environment						
Urban area					1.000	
Town area	1.505	0.412	13.311	0.000	4.502	2.006–10.104
Rural area	0.175	0.348	0.253	0.615	1.191	0.602–2.354
Frequency of participation in club activities						
Often					1.000	
Sometimes	-1.856	0.822	5.099	0.024	0.156	0.031–0.783
Occasionally	-1.615	0.630	6.583	0.010	0.199	0.058–0.683
Never	-1.360	0.624	4.755	0.029	0.257	0.076–0.871
Knowledge of general practice/general practitioners before the course						
Yes						
No	-1.094	0.353	9.599	0.002	0.335	0.168–0.669

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Variable	B	SE	Wald	*P*	OR	95% CI
Participated in practical activities (including volunteer work)						
Yes						
No	-0.969	0.387	6.280	0.012	0.379	0.178–0.810
Attentive to the country's current state and development of medical treatment						
Yes						
No	-1.174	0.383	9.371	0.002	0.309	0.146–0.656

3.3. Course summative assessment

The results of the course summative assessment were as follows: (i) 91.8% of students said that it is necessary to learn this course; (ii) 33.9% of students felt that the most important thing in the course is to learn the theoretical knowledge of general medicine and related diagnosis and treatment skills; 26.2% learned the concepts and clinical diagnosis and treatment skills that could be used in future learning and work, 28.8% had an understanding of the work content of general practitioners/community health services, 11.2% had a broader vision of medicine and medical career, 53.2% stated that the most unfavorable factor affecting the learning of this course is the lack of interest in the major, 22.7% were not satisfied with the course content, 2.1% were not satisfied with the teachers' professional level, 21.9% were not satisfied with the form of teaching, and 64.4% wished to participate more in community practice to understand and participate in the practical work of general practitioners; (iii) the paired sample *t*-test showed that there were differences in career preferences before and after the course ($P < 0.05$), and more students felt that being a general practitioner is the preferred career option after the course (see **Table 4**).

Table 4. Paired sample *t*-test

	Paired differences					*t*	df	Significance (2-tailed)
	Mean	Standard deviation	Mean standard error	95% CI of the difference Lower	Upper			
Before course-after course	0.129	0.509	0.033	0.063	0.194	3.860	232	0.000

3.4. Professional interest tendency

The results showed that (i) 58.8% of students had considered their future specialty but had no specific goals or plans, 21.9% had considered their future specialty and had clear goals, 0.9% had considered their future specialty and had plans to be a general practitioner, 7.7% had considered their future specialty and had plans to engage in medical-related work outside clinical work (including basic medicine, *etc.*), 0.9% had decided not to engage in medical-related work, and 9.9% had not decided on their future specialty; there was significant difference in professional inclination between different genders as well as those who are attentive to the current state and development of medical treatment in our country and those who are not ($P < 0.05$); (ii) with regard to the scores of importance in terms of the influencing factors of students' professional inclination, interest and possibility of professional development scored 3.92, ranking first, followed by income, which scored 3.91. The scores of intellectual challenges in daily work, work-life balance, long-term doctor-patient relationship, and future work place were 3.65, 3.79, 3.84, and 3.86, respectively. Professional soundness scored the lowest (3.62).

4. Discussion

4.1. Pre-course needs assessment: Focus on improving students' interest in general practice and pay attention to the improvement of students' course cognition, including pre-course professional understanding, the development of relevant practical activities, and awareness of the current status and development of medical treatment in the country

Although many medical colleges and universities have implemented this course as a compulsory course for undergraduate clinical medical students [2,3], aiming at attracting more students to engage in general practice, as a result of the introduction of national policies that emphasize on cultivating talents in general practice as well as encouraging and guiding them, in hope to promote the development of general practice education in our country, the results of this survey showed that 67.0% of students were still unaware about general medicine and general practitioners before the course, and only half of them expressed interest in this course. Our findings are similar to other research conclusions [4]. It is clear that a strong primary healthcare system is more likely to deliver better population health, better health equity, and better use of economic resources than a system oriented toward specialist care and that developing and maintaining a strong and sustainable primary healthcare system requires a significant proportion of medical graduates to support the primary healthcare system. However, attracting a large number of medical students to continuously provide human resource support to this group of practitioners presents a major challenge to the policy formulation and development of general medicine in many countries [5]. Through the pre-course needs assessment, we found that there were differences in interest toward the course ($P < 0.05$) among different growth environments, frequency of participation in community activities, knowledge of general practice/general practitioner before the course, participation in practical activities (including volunteer work), and attentiveness to the current state and development of medical treatment in China. Further multi-factor logistic regression of the above factors showed that the factors influencing the development of interest among clinical medical students in the course include growth environment, frequency of participation in community activities, course cognition, participation in general medical practice, and attentiveness to the current state and development of medical treatment. The higher interest of students brought up in urban and rural areas may also have a more direct relationship with the current policy of rural order-oriented free medical undergraduate talent training. However, this course draws more interest from students who often or sometimes participate in community activities, students who are aware of general medicine and general practitioners before the course, students who have participated in practical activities (including volunteer work), and students who are attentive to the current state and development of medical treatment in our country. This also suggests that before implementing the course, more emphasis should be given to the practical significance of the development of general practice and the progress of the current national medical reform among students; moreover, the course content organically integrated with campus club activities and practical activities (volunteer work), so as to increase the chances of students being in touch with general practice in advance and thus enhance their interest in the course.

4.2. Course summative assessment: The implementation of this course has a positive influence on the career preferences of clinical medical students to a certain extent

General medicine can be divided into two parts: general medicine and monograph. "Introduction to General Medicine" mainly introduces the characteristics, basic concepts, and theories of general medicine, as well as its role in the healthcare system [6]. After the course, 91.8% of students felt that it is necessary to learn this course. The results of the assessment also showed that the course objectives have been achieved. However, half of the students mentioned that the most unfavorable factor affecting the learning of this course is the lack of interest in general medicine. In addition, some students were not satisfied with the course content and form of teaching, and 64.4% wanted to have more community practice teaching in order

to understand and participate in the practical work of general practitioners. This course involves a wide range of theoretical content, and the current arrangement of the course is still dominated by theoretical class hours. In addition, the teachers lack teaching experience, the teaching methods are dominated by traditional teaching methods, and the students do not participate much. This situation is different from that in foreign countries [7], and it is unable to satisfy the full cognition of general medicine. In the revision of the curriculum, there is a need to consider transforming the teaching strategies and exploring new teaching forms [8]. Teachers should pay attention to case collection and combine boring theoretical knowledge and general case practice with more diversified teaching forms, such as situational teaching and role exercise, so as to increase learning opportunities for students and provide them a platform to share their personal views. In self-directed step-by-step learning, students must put themselves in the role of a general practitioner, so as to understand and master the real concept of general practice as well as the responsibility of a general practitioner as the gatekeeper of primary healthcare. In that way, they will be able to develop further interest in general medicine and be more willing to learn new skills [9-12]. The paired *t*-test showed that there were differences in the results of students' career preferences before and after the course ($P < 0.05$). After the course, more students felt that being a general practitioner is the ideal career option, indicating that the implementation of this course had a positive influence on the career preferences of clinical medical students to a certain extent and this positive influence should be extended to the above curriculum revision.

4.3. Unclear professional inclination, and work value orientation influenced by interest and possibility of professional development

Our study showed that the students' professional inclination was generally unclear and the influencing factors of students' professional inclination, namely work value orientation, were as follows: interest and possibility of professional development, followed by income, and professional prestige as the least important. Therefore, it is necessary to combine the course content with the development of general medicine, so as to stimulate the self-driven learning interest of medical students and their interest in general medicine. This will attract more students whose work value orientation is influenced by interest and possibility of professional development to choose general practitioner as their future professional inclination.

The revision of this course should be based on the current professional development situation of general medicine, the gradual improvement of the course content, the formulation of course goals and objectives, the selection of education strategies conducive to the course, and the continuous evaluation of the course to ensure continuous improvement. In this way, we can ensure its appeal to students. Other than that, students' interest in self-directed learning will be better stimulated, and they will be more willing to pursue professional development through course learning, thus supplying more talents to the team of general practitioners in China [13-15].

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Disclosure statement

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Remote Learning in Higher Education During the Pandemic: A Study of the Experiences of Chinese International Students at United Kingdom and United States Universities in 2020/21

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Abstract: During the COVID-19 pandemic crisis, many universities around the world made a drastic change by transferring most of their offline classes to emergency remote learning (ERL). The aim of this study was to explore how Chinese students, who studied in United Kingdom (UK) and United States (US) universities during the 2020/21 academic year, perceive their experiences of remote learning. As the UK and the US have two relatively advanced education systems, the arrangements of their universities for ERL and their support for international students are worth exploring. Moreover, during the ERL, a portion of Chinese students had online classes in their home countries instead of the country in which their universities are located. Therefore, semi-structured interviews were carried out to explore the academic experiences and social interaction of students who studied in UK and US universities, while remaining in China. The data were analyzed using the thematic analysis method. The findings showed that ERL was perceived negatively by students despite its flexibility in areas of academic learning experiences and social interaction.

Keywords: COVID-19; Emergency remote learning (ERL); Chinese students; Academic experiences; Social interaction

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1. Introduction

COVID-19 was declared as a pandemic by the World Health Organization (WHO) on March 11, 2020 [1]. In the context of education, the lockdown of countries is equivalent to the lockdown of the education system [2]. Based on the United Nations Educational, Scientific and Cultural Organization (UNESCO) [3] data, on April 13, 2020, a month following the declaration of COVID-19 as a pandemic by WHO, more than 1.134 billion students, accounting for over 72% of the world's enrolled learners, were affected by the 117 country-wide closures.

It is rare to see a sudden shift to online learning on such a large scale in emergency. Emergency remote learning (ERL) might share some similarities with distance education at first sight since it is conducted on digital learning platforms with physical separation between teachers and students. However, unlike the former, distance education is planned to be conducted at such physical separation in the first place [4]. Distance education is an education pattern in which individuals are not restricted by learning resources and time [5]. Accompanied by the rapid development of digital technology and the internet in recent decades, distance education has gradually become an important part of educational institutions [6]. It is appreciable that distance education had already been used by higher institutions even before the pandemic.

The shift to ERL during the lockdown forced traditional teaching and learning to be replaced by distance education. Although distance education is not new, its application in emergency situations such as the pandemic can be challenging. Teachers, digital technicians, and even students were not adequately prepared to handle this unexpected situation. For instance, most university professors have never taught online before or have limited experience and only attempted to upload teaching materials for students to learn [2]. Similarly, most students have never experienced a complete online learning environment that requires collaboration with both their teachers and classmates using technologies [2]. Thus, it is crucial to explore the challenges in this unique experience and make improvements to better prepare for potential future disruptions.

In the past few years, research related to ERL has been emerging. However, literature on international students' experiences of ERL is limited. Therefore, the online learning experiences of Chinese international students who have been kept away from UK and US universities in 2021 were explored, and the following research questions were addressed: "How did ERL during the pandemic shape the experiences of Chinese international students?" This question can be further divided into two specific questions: (i) How did ERL impact students' academic experiences? (ii) How did ERL influence students' social interaction?

2. Literature review

2.1. Definition of distance education and emergency remote learning

According to Moore [7], distance education used to be regarded as a pedagogical concept that described the relationships between teachers and learners when they are separated by space and/or time [8]. Over two centuries, distance education has transformed from mail and letter to radio and television, and now to web-based technologies [8,9].

Later, distance education was traditionally defined as obtaining education opportunities through satellite, audiovisual, computerized, and multimedia technology tools [10]. Nowadays, distance education or e-learning mainly refers to virtual learning processes that are supported by the online interface system, including the computer, social media, internet, database, and web technology [11]. In view of its flexibility, distance education has been regarded as a promising innovation, which allows students to study at their own time and place in a "self-paced" learning environment [12,13].

More recently, due to the lockdown, educational activities in countries around the world mainly took the form of distance education. However, such distance education is a crisis response and should be regarded as ERL, distinct from the traditional definition and context of distance education. Prior to the COVID-19 pandemic, teachers had limited experience with online teaching [14], and the process of transferring to online classes also lacks careful design and developmental process [15]. As a result, Hodges *et al.* [16] highlighted the difference between well-planned online courses and the crisis-response, "emergency remote teaching (ERT)," a term used interchangeably with ERL [17-20]. Once the crisis or emergency situation abates, the normal teaching or educational methods will be resumed; thus, the main purpose is not to re-establish a healthy educational ecosystem, but rather to provide occasional education and teaching support in a way that can be reliable and quickly set up during emergencies or crises [16].

2.2. Emergency remote learning: Learning efficiency and satisfaction

2.2.1. Student-teacher interaction in synchronous and asynchronous classes

Online classes can be categorized as recorded (asynchronous) or live (synchronous) [21]. Synchronous classes require faculties and students to be present online simultaneously to facilitate interaction through virtual platforms, such as Zoom [22,23]. Asynchronous e-learning utilizes tools such as discussion boards and e-mail to foster teacher-student relationships even when offline [24]. Students generally prefer synchronous classes over asynchronous ones due to their effectiveness and potential for learning communities [24,25].

Interaction is essential in education, especially the interaction between teachers and students, which affects many different aspects of learning. A study has shown that among the dimensions of ERL, the teacher-learner interaction dimension is a significant element that could affect the satisfaction of learners [26]. During the pandemic, the lack of interaction has created many problems in the shift to ERL. For instance,

after transferring to ERL, almost 90% of students in a university reported that they felt the level of interaction in the course decreased, and approximately 70% of students considered that the change in the level of interaction had negative impacts on their learning [27].

In terms of interaction during classes, synchronicity is often regarded as a vital indicator of interaction, and most students attach great importance to it. For example, Ramo *et al.* [28] found that students showed preference for live lectures on video conferencing platforms (*e.g.*, Zoom), as these lessons offered opportunities for interaction with their classmates and teachers in real time, thus making the lessons more interesting. There were also students who expressed that they are more motivated and engaged in synchronous remote learning when compared to asynchronous learning [29]. In another study, several students pointed out that synchronous classes provide a sense of "attending" lectures, which helped with keeping them motivated and engaged [27]. This positive impact of synchronous remote learning might be partially attributed to the social presence and verbal immediacy in real-time interaction, which could improve students' satisfaction and motivation [29-33].

Besides, the interaction issue also involves how teachers make use of digital technology and design their classes under the ERL context. Students tend to have fewer opportunities to communicate with teachers during the ERL period because of the limited time or space of virtual communication. In a study by Özer *et al.* [34], a student described that they could ask questions anytime when they were at school, but with online classes, they could only communicate with the teachers within the limited class hours. Moreover, the spontaneous chances for students to interact with the teachers before/after class or during the teachers' office hours cannot be replicated adequately during ERL instruction [35]. Although there are challenges that might be beyond the teachers' control, students' responses from surveys have indicated that teachers can in fact control some of the factors, such as students' questions during lectures [36]. In short, from a student's perspective, teachers could provide more support for a smooth transfer to ERL, especially in terms of opportunities for communication and discussion.

2.2.2. Impacts of remote learning on students' study environment

Amid the COVID-19 pandemic, students had to take online classes from their homes or dormitories due to travel restrictions, and many universities had to operate under online teaching patterns. Some students could not adapt to the new academic environment at home, as they were used to face-to-face classroom learning [37].

According to Huang [38], 40% of students do not have an effective learning environment at home due to various reasons, such as distractive noises and digital devices, leading to low learning efficiency at home. Likewise, 45.6% of students found it difficult to find their own quiet space to have ERL in their family environment, according to Giusti *et al.* [39]. Accountability should be emphasized in classroom education, especially for students with self-discipline issues. For instance, previous studies have shown that students may have difficulties focusing on lectures while on the phone because "now no one is keeping me accountable" [40].

2.2.3. Time difference

Studies on remote learning during the pandemic have shown the impact of time zone differences on international students [41-44]. Ciano *et al.* [45] suggested that time zone differences should be considered when designing ERL courses for international students. Even within the same country, Pacific Time Zone students found starting classes at 9 a.m. (EST) challenging [46]. For Chinese students studying in the US or UK, the time difference requires them to adjust their daytime activities and sleeping schedules, which may lead to health problems [46,47]. Time zone differences can also create inequalities in learning conditions, with international students staying up late to attend synchronous classes [48]. Organizing synchronous online teaching can also be challenging for teachers due to different time zones [48,49].

2.3. Social interaction

Matarirano *et al.* [50] found that during the COVID-19 pandemic, students were forced to stay at home and

away from their social ties, implying that ERL has negative impacts on students' social lives. Schools are responsible for fostering students' academic learning and socio-emotional development, the "hidden curriculum" that covers the social and cultural characteristics of schools [51]. However, remote learning makes it more challenging for teachers to arrange "out-of-class" opportunities and activities that support socialization. Students have to take the initiative to organize and create opportunities for socialization in distance education [52].

Studies have shown that students feel isolated from their lecturers and peers during the ERL period [53,54]. Due to social distancing measures, it is difficult for students to interact with their teachers and peers; international students experienced difficulties returning to their campuses, while exchange students were restricted to their residence [55]. Kedraka *et al.* [56] found that the most missed aspect of university life by students during the COVID-19 pandemic and ERL was social interaction. Specifically, 76% of students missed their classmates, 76% missed social interaction, 70.6% missed face-to-face communication during lessons, and 61.4% missed their teachers [56]. Students have also realized that ERL lacks interpersonal communication experiences and connections with other students [57] and does not provide a sense of community [57,58].

2.4. Advantages of emergency remote learning during the COVID-19 pandemic

Despite the aforementioned challenges, ERL has some advantages. For instance, remote learning provides flexibility to those who cannot access education in a fixed time and space [59-63]. In addition, ERL can help students save expenses since they do not have to spend money on stationeries and transportation [62]. A study has shown that students were also satisfied that ERL saved the traveling time between classes [61].

3. Methodology

This study aimed at exploring the ERL experiences of Chinese students at UK and US universities during the COVID-19 pandemic period. For this study, an interpretivist, qualitative approach was used in order to provide an in-depth and explanatory understanding of the participants' social world through exploring and understanding their social and material environments, experiences, and opinions [64].

3.1. Participants

Four Chinese students including two US university students (one male and one female: US-F and US-L) and two UK university students (one male and one female: UK-Z and UK-G) were interviewed. They were having ERL in China during the 2020/21 academic year because of the pandemic. However, since UK and US universities have different arrangements for their ERL (*e.g.*, some US universities partnered with Chinese universities and allowed students to take offline classes on the university campus in China), both types of ERL were included in this study.

3.2. Positionality

According to Savin-Baden *et al.* [65], positionality reflects the position that a researcher chooses to adopt in a given research. Positionality could influence the whole research process [66]. I took into account of my role in this study as a researcher. All of the participants were my acquaintances, and we had discussed their ERL experiences before the research. Hence, I recognized the need to lessen the influence of bias toward their responses in the data collection process. As I went through the whole process, I also had some preconceived notions and experiences with ERL. Therefore, in order to ensure objectivity in the research process, I made an effort to avoid being influenced by my own past experiences.

3.3. Data collection

The purposive sampling technique, where the researcher identifies participants who can provide information based on their experiences or knowledge, was used [67]. Therefore, the screening was done by emailing potential participants with questions to check if they have experiences relevant to this study. Before the interview, each participant signed two copies of the "Adult-Participant Consent Form," as per

required by the research ethics committee at the University of Sheffield. The one-on-one interviews ranged from 3 minutes to 60 minutes. The semi-structured interview method was adopted in which open-ended questions were posed so that the participants could answer freely. It also allowed the researcher to probe answers with improvised follow-up questions [68].

3.4. Data analysis

The audio recordings of the interviews were transcribed by software tools to automate the process. Thematic analysis was conducted to recognize the patterns within and across data related to the participants' lived experiences, opinions, practices, and behavior. Based on the procedures described in previous studies [69], the transcripts of all four interviews were read and analyzed for major themes, which were combined based on commonalities.

4. Results and discussion

4.1. Impacts of emergency remote learning on students' academic experiences

4.1.1. Mixed experience of classroom interaction

In this study, the majority of participants valued interaction in ERL. This finding is consistent with previous research on remote learning prior to the pandemic, which pointed out that students in online learning environments may have limited interaction, including student-teacher interaction, student-student interaction, and student-content interaction [70]. The general lack of communication and interaction in ERL has also been mentioned in a report on the COVID-19 pandemic [9].

Overall, the participants agreed that live classes have many advantages, especially in improving in-class interaction and student engagement. Two students (UK-G and UK-Z) preferred live classes over recorded ones. The interaction with their teachers and classmates or even the mere presence of them meant a lot to the participants. For instance, participant UK-G expressed, "I really enjoy having the live class more than the recorded one. I can interact with the teacher and my classmates, and it lets me feel more engaged and active." This is similar to a study done by Ramo *et al.* [28], who found that students are more interested when they can interact with their classmates and the teacher through breakout rooms in Zoom during lessons. Moreover, participant UK-Z shared that having classmates attend synchronous classes together gives him a sense of "being in the classroom." This is consistent with the findings of previous studies that have demonstrated increased engagement among students with the presence of others in live classes. In addition, participant UK-G stated that the guidance of teachers in leading them to the next topic improved their ability to focus, highlighting the importance of immediate teacher support for students to keep up with the lesson.

Beyond teachers' guidance in lesson contents, immediate feedback from teachers is also important. US-F and US-L felt that they could ask questions at any time during live classes, as they could communicate directly with the teacher and receive the answers immediately. Apart from teachers' guidance and feedback, both of which are associated with learning efficiency, synchronous classes provide more inspiration. Participant UK-G emphasized on the importance of real-time group discussions during live classes, as she could listen in to different perspectives shared by her classmates, and she believed that "every discussion is a clash of ideas."

Although live classes allow students to engage with each other in real-time, other factors might compromise the advantage of such synchronous interaction. This is because there is a choice between turning the microphone or camera on and off during live classes. All of the participants were reluctant to turn on their cameras, whether in large lectures or small seminars, except upon request by their lecturers.

All participants cited time difference as the reason for attending live classes late at night and often felt self-conscious about their appearance in front of the camera. Moreover, the participants also preferred keeping their microphones off due to disinterest or lack of confidence in their English proficiency. However, they were well aware of the fact that the probability of interaction decreases in breakout rooms or discussions when they do not turn on their cameras or microphones. Participant US-L noted that group discussions were mostly silent since nobody turned on their cameras or microphones, resulting in a lack of engagement. US-L further said, "It is usually late at night, and students like me in China are usually

exhausted because we already have offline classes during the day. Hence, I cannot concentrate well and do not want to answer in class even through the chat box." In short, if most students do not turn on their microphones and cameras, the efficiency of interaction and benefits brought by live classes may be affected.

Students' in-class interaction is also related to the lesson design and the use of technology by teachers. The active communication in remote learning provided by teachers could yield better results [71]. For instance, participant UK-Z mentioned a successful experience in which his teacher made use of the green screen. Upon placing the slides on the green screen, his teacher placed himself at the bottom left of the slides. This made UK-Z and his classmates feel more like a face-to-face lesson, which helped them focus, as they were more likely to interact with the teacher in that situation. This shows that the thoughtful use of digital technology can enhance the efficiency of learning during lessons in some ways.

While well-planned online classes enable effective interaction, failures to adapt to ERL may have the opposite effect. Participant UK-Z's experience with an older professor who struggled with technology highlighted the need for teacher training. Inadequate technology preparation is a major challenge in hybrid or online learning environments. Trainings should address adapting course content for online classes. Participant US-F encountered a teacher who just read from the slides, with limited interaction. US-F said, "I felt that my teacher did not design and provide interesting lesson contents and interaction through proper use of technology. I thought that the class was so boring." According to Adedoyin *et al*. [72], most teachers are still not prepared to provide high-quality teaching remotely.

4.1.2. Time difference causing changes in learning and sleeping patterns

The participants in this study who were physically located in China felt that their learning efficiency was reduced, as they were forced to change their learning patterns due to the time difference. For instance, the participants who attended UK universities reported that they go to bed on average 2–3 hours later than their regular bedtime as their classes end at 2 or 3 a.m. in their own time zones. Moreover, their entire daily learning schedule was forced to be put off: the usual morning activities were postponed until afternoon, and the afternoon ones until evening. They found it difficult to even get a good night's sleep, resulting in the lack of energy during both day and night and the inability to focus on learning. Participant UK-Z stated, "It was so difficult to achieve high learning efficiency at night when I have to change my learning pattern and go to bed later than usual." Participant UK-G shared that although she usually stays up late, she spent most of her time on leisure activities instead of learning. Therefore, she felt as though she was not doing enough for academic work late at night. The participants attending US universities had an even tougher schedule, as they had offline classes during the day and attended online live classes in the US time zone. Thus, when forced to take online classes at night due to the time difference, achieving the same learning efficiency as during the day became a challenge. This impacted the students negatively. It is also unfair for those in other time zones to postpone their studies until the evening for synchronous online teaching [48].

Moreover, there is often a delay in the feedback from teachers because of the time difference, and students do not get the answers to their questions in a timely manner. As a result, the time to complete the learning tasks lengthens. According to Villa-Rojas *et al*. [73], teacher-student interaction is challenging if students are in different time zones or have restrictions on accessing the online discussion tools. The participants reported that arranging the time for their one-to-one online meetings with their teachers took a lot of time due to the time difference. Xu *et al*. [74] also reported that because of the eight-hour time difference between China and the UK, creating a schedule suitable for both supervisors and students was a challenge.

4.1.3. Internet access problems

During the COVID-19 pandemic, several Chinese students returned to China and participated in the ERL organized by UK or US universities. However, there was hindrance to their learning due to the internet censorship and the Great Firewall. As Wang [43] has pointed out, ERL is at risk of technological failure because of their high dependence on technological infrastructures, such as transoceanic networks and electronic devices. In this study, all the participants encountered problems with internet connection and the

use of the virtual private network (VPN) in China. They felt that it had negative impacts on their learning efficiency and motivation.

The participants encountered some network-related difficulties during online live classes in China, such as blurred and fuzzy screens due to network latency, as well as bad-quality audio transmission. UK-Z and US-F noted issues with their teacher's voice being cut off at times and presence of electrical noise, likely due to unstable internet connection caused by the VPN used in China to bypass the Great Firewall. Similarly, Wang [43] found that Chinese international students faced uncertainties and disruptions in ERL due to VPN instability. The lack of stable internet access may affect learning negatively, including compromising students' understanding of lesson content and limiting their interaction with the teachers. For example, UK-Z shared his difficulty in understanding the teacher during class, while US-F experienced a time when she did not even hear the teacher call on her to answer a question during a live class. All these failed experiences might pile up and lead to low motivation for learning. Participant US-F said, "I think it is unnecessary to attend such classes where nothing can be heard and the learning effects are poor." As suggested by Breines *et al.* [75], the limitations of technical infrastructure could cause frustration among international students and affect the efficiency of online courses.

In addition, Chinese students also face problems accessing certain academic sources due to the Chinese internet censorship. According to Gueorguiev *et al.* [76], ERL poses extra challenges when a lesson contains content that the Chinese government considers sensitive. Participant UK-G had regular weekly film screening to watch the assigned film but some of the movie titles or links provided were blocked in China. In such context, students would need to spend more time on resource acquisition, thereby reducing their learning efficiency and passion for learning. Participant UK-G shared, "I lost enthusiasm for some content, and my expectations were frayed because I had already spent too much time looking for resources." Even worse, they are prone to anxiety or depression when the materials and information cannot be found. As emphasized by Wang [43], the inability to access educational information and certain websites could create feelings of displacement and insecurity in the students' overall immobile state in ERL.

4.1.4. Lower concentration when studying at home

The participants mainly studied at home since home provides a quiet environment. However, the participants found it difficult to concentrate at home, which may have reduced the learning efficiency. The participants shared that they usually studied in a quieter place at home, such as their bedroom or study room, especially when they need to interact with others. For example, participant UK-G pointed out that she usually had live seminar classes in her own room and kept her younger siblings from entering her room. She believed that a quiet environment is essential for interaction with the teacher and her classmates. Similarly, Massis [77] stated that quietness, as a critical factor impacting learning effectiveness, is needed for students to study and reflect. According to van der Voordt [78], students prefer a quiet place over a busy place, as they seem to do better in a quiet environment. Based on this, Rahiem [18] discovered that students preferred studying in a quiet and comfortable place during the pandemic period, such as closed rooms or family rooms at home. On the contrary, the home environment is not an ideal learning place for all learners. For instance, participants US-F and US-L shared that they often became distracted and laid down on their beds when they were having classes because of the late-night classes, which seriously affected their learning efficiency. Their experiences shared commonalities with the claim that the home environment is relaxing, which is even harder for them to focus on tasks than in the classroom [79-81].

4.2. Reduced social interaction

Findings from this study showed that the impacts of ERL are more complicated than merely having negative effects on students' social aspects. Although for some students, their normal social mentality and activities were affected by the ERL, most of them felt that their social life was not seriously affected. They felt that they could find ways to compensate for it.

UK-Z shared that he usually stayed at home during the ERL period and it was difficult for him to have face-to-face contact with his friends or classmates. Therefore, his normal social mentality was affected,

resulting in anxiety and social phobia. He pointed out, "I'm missing the days when I could freely meet my classmates face-to-face without any social restrictions." Similarly, Kedraka *et al.* [56] stated that the social aspect is the part that most students miss the most of their university life. When talking about the causes of his social phobia, he shared that as he had not met people face-to-face for such a long time, his ability to interact with people offline and analyze their facial expressions and verbal movements might have deteriorated. This was the main reason he had social phobia.

On the other hand, all the other participants did not feel their social life was affected, and despite the fact that they could not meet many of their local American or British classmates in their universities, they did not feel troubled. For them, ERL, resulting from the pandemic, enabled them to interact more with their family members and friends in China. For example, UK-G mentioned that she felt less lonely than when she was taking offline classes in the UK, as her family and friends are in China. Moreover, she also had the opportunity to play the drums and travel with her family on weekends. She felt fulfilled and happy socially when she had ERL in China. She even mentioned the word "happy" several times during the interview. From her point of view, ERL had impacted her social life in a positive manner. In addition, US-L had a positive attitude toward the influence of ERL on her social interaction. She shared that she had managed to build close rapport with her family during this period, as she had not been in China for such a long period of time due to her studies in the US; she and her family were very happy with the family union. UK-G and US-L also shared that they would usually go out to meet their old friends over dinner and spend some time together during their free time in China. According to Elmer *et al.* [82], as social distancing measures minimize face-to-face interactions and random encounters with other people, individuals tend to focus on the relationships that are close in space, most meaningful, and most established; these relationships may exist outside the student community, such as at home and within the family [83]. Social interactions with "old friends" also fall within relationships that are "most established," *i.e.*, friendship circles that have been previously established [83].

This finding can be understood with the identity of Chinese students in western countries. It has been reported that racial or ethnic minorities, as well as international and lower socioeconomic status students are more vulnerable to the risk of social isolation [84]. Particularly, the quality of social support received by Asian students, who have been classified as "other or multiple" racial or ethnic groups, has significantly reduced [84]. As a result of social isolation due to the pandemic, the probability of depression among Chinese students might increase, but allowing them to return home and reunite with their families and peers might be just what they need. Due to racial homophily and, to a lesser extent, ethnic homophily, Chinese are more likely to make friends with Chinese [85], and when Chinese students return to their home country and meet those who share the same culture, the feeling of social isolation may diminish. US-L even said, "We are so happy that we wish that the US side would never have face-to-face classes again (in terms of social interaction)."

4.3. Future recommendation

All the participants hoped that some components of ERL would be integrated into face-to-face teaching when it resumes in the future, so as to save time and improve learning efficiency. They expressed their desire for large lectures and short one-on-one tutorials to be moved online, while other classes that require interaction with their classmates to remain offline. By taking advantage of ERL, it saves accommodation and transportation costs as well as the commuting time, especially for those who live far from the campus [86]. According to UK-G, she would no longer need to spend 30 minutes walking to the campus just for a 15-minute tutorial and it would be more beneficial for her time management in terms of learning if this kind of blended pattern could be adopted in the future.

5. Conclusion

In this study, the ERL experiences of Chinese students in UK and US universities during the COVID-19 pandemic period were explored. The findings suggest that the efficiency, effectiveness, and motivation for learning may be affected in ERL despite its potential advantage of flexibility in terms of time and location.

Time differences, poor internet access, and ill-suited home environment could lead to low learning efficiency among students. Additionally, lacking the sense of "attending" lectures and reduced classroom interaction may negatively impact students' motivation to learn. Furthermore, remote learning may have detrimental effects on students' social interactions, ultimately affecting their ability to learn. These outcomes largely result from technical problems and the inadequate support from schools and teachers.

The findings from this study suggest three improvements for online teaching and learning. Firstly, in lesson design, the feelings and perspectives of students should be considered, and it should fit the specific context of online teaching and learning, including the time at which classes start, the duration of each lesson, and the adjustment of teaching methods. Secondly, it is necessary to further improve teachers' technology skills to enhance the quality of remote teaching. Lastly, concerning students' social interaction, universities should provide additional support and address the challenges faced by international students in social interactions, whether during remote learning or when they return to campus.

It is worth noting that several factors may have contributed to the limitations of the findings. Firstly, the findings are mainly based on students' personal reflections on their ERL process, potentially overlooking some external factors that could influence their perspectives. Additionally, the varying lockdown policies across the Chinese cities where the participants lived were not considered, which could have had impacted their ability to adapt to their study environment. In consideration of these factors, the findings of this study might have some limitations. In addition, only students' perspectives were considered in this study; the perspectives of other stakeholders such as teachers or universities were not considered. The perspectives of teachers and the support provided by universities should be examined in future research.

Disclosure statement

The authors declare no conflict of interest.

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[1] Yao Y., Xia B. Application of Phase Frequency Feature Group Delay Algorithm in Database Differential Access. Computer Simulation, 2014, 31(12): 238-241.

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[2] Gamelin F.X., Baquet G., Berthoin S., et al. Effect of high intensity intermittent training on heart rate variability in prepubescent children. European Journal of Applied Physiology, 2009, 105: 731–738.

Journal article (online) with one to three authors

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[4] Hargreave M., Jensen A., Nielsen T.S.S., et al. Maternal use of fertility drugs and risk of cancer in children—A nationwide population-based cohort study in Denmark. International Journal of Cancer, 2015, 136(8): 1931–1939.

Book

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[5] Schneider Z., Whitehead D., Elliott D. Nursing and midwifery research: methods and appraisal for evidence-based practice. 3rd edn. 2009, Elsevier Australia, Marrickville, NSW.

Book with more than three authors

[6] Davis M., Charles L., Curry M.J., et al. Challenging spatial norms. 2013, Routledge, London.

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No author

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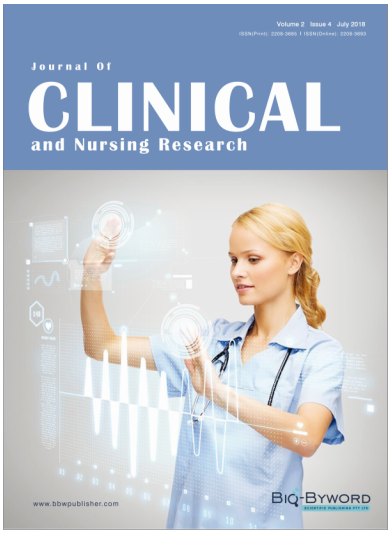

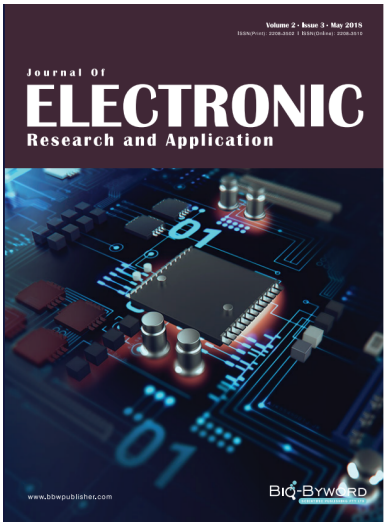

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