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Construction and Empirical Research on the Evaluation Index System for Online Teaching Quality: A Case Study of Sports Rehabilitation

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Abstract: With the rapid development of online education, it has become crucial to assess and ensure the quality of online teaching in various fields, including sports rehabilitation. This paper aims to construct an evaluation index system for measuring the quality of online teaching in the context of sports rehabilitation and conduct empirical research to validate its effectiveness. In the construction of the evaluation index system, a comprehensive and systematic approach was adopted. Through literature review, expert consultation, and data analysis, a set of key indicators relevant to online teaching quality in sports rehabilitation was identified. These indicators cover various aspects, such as content design, teaching methods, interaction, assessment, and student satisfaction. To validate the effectiveness of the evaluation index system, empirical research was conducted. A sample of sports rehabilitation online courses was selected, and data was collected through surveys and assessments. The collected data were analyzed using statistical methods to examine the relationship between the evaluation index system and the overall teaching quality. The research findings indicate that the evaluation index system for online teaching quality in sports rehabilitation is reliable and valid. It effectively captures the essential elements that contribute to effective online teaching and provides a reliable measure of teaching quality. Moreover, it offers valuable insights and practical guidance for educators and institutions to enhance their online teaching practices in the field of sports rehabilitation.

Keywords: Online Teaching Quality, Evaluation Index System, Sports Rehabilitation, Empirical Research

1. Introduction

With the rapid advancement of internet technology, online education has gained significant popularity worldwide. Particularly in recent years, the outbreak of the COVID-19 pandemic has placed severe limitations on traditional face-to-face teaching methods, making online education a primary means of continuing education [1-3]. Online education not only provides students with flexible learning opportunities but also facilitates the dissemination of knowledge and global access to education. While the rise of online education brings numerous opportunities, it also presents challenges, one of which is assessing and ensuring the quality of online teaching [4].

The field of sports rehabilitation, as a specialized discipline, places particular importance on the assessment of online teaching quality. Sports rehabilitation encompasses the prevention of sports injuries, rehabilitation treatment, and functional recovery, requiring a combination of theoretical knowledge and practical application in teaching. In traditional face-to-face teaching environments, instructors can directly interact with students and provide on-site guidance. However, online education necessitates the use of technological tools to achieve teaching effectiveness. Therefore, evaluating the quality of online teaching in sports rehabilitation involves considering not only the design of course content and the effectiveness of teaching methods, but also the level of interactivity between students and instructors, the scientific nature of assessments, and student satisfaction with the learning experience [5].

To address this issue, this paper aims to construct an evaluation index system for measuring the quality of online teaching in the field of sports rehabilitation and validate its effectiveness through empirical research. The construction of the evaluation index system adopts a comprehensive and systematic approach, incorporating literature reviews, expert consultations, and analysis of real-world online teaching data [6-8]. By identifying key indicators, we can comprehensively and accurately assess the quality of online teaching in sports rehabilitation.

This study's contribution lies in providing a scientifically valid evaluation index system as a practical reference for assessing online teaching in sports rehabilitation. This will assist educators and educational institutions in understanding the quality of their online teaching practices and guide improvement. Additionally, students can benefit by selecting high-quality online courses in sports rehabilitation, thereby enhancing their learning outcomes and satisfaction.

In the future, as online education continues to evolve, the evaluation index system will undergo further refinement and enhancement [9-13]. By integrating emerging teaching technologies and methodologies, combined with feedback from students and instructors, the accuracy and practicality of the evaluation index system can be further improved. The research findings in this paper provide valuable insights and guidance for assessing online teaching quality in the field of sports rehabilitation, creating a better teaching environment and learning experience for both students and educators.

2. Theoretical Research

2.1. Theoretical Framework for Assessing the Quality of Online Teaching

In the field of online teaching quality assessment, researchers have proposed evaluation frameworks based on different theoretical perspectives [14-16]. For example, one scholar has proposed an assessment framework for online teaching quality based on constructivist theory. This framework establishes a series of evaluation indicators from aspects such as student participation and interaction, teacher guidance and support, and learning outcomes. This study provides a theoretical foundation for evaluating the quality of online teaching and serves as a reference for constructing the indicator system in this research [17].

The application of traditional face-to-face teaching evaluation systems in online teaching quality assessment has also been explored to some extent. Scholars have studied the feasibility and effectiveness of incorporating traditional face-to-face teaching evaluation systems into online teaching. The research results show that some traditional teaching evaluation indicators, such as student engagement, classroom interaction, and learning outcomes, can be partially applicable to online teaching, providing references for evaluating the quality of online teaching [18, 19].

Learning analytics and data mining techniques play an important role in online teaching quality assessment. Scholars have studied the feasibility of applying learning analytics and data mining techniques to evaluate online teaching quality. By analyzing students' online behaviors and learning data, researchers can extract important evaluation indicators, such as student learning activity, learning outcomes, and learning difficulties, to evaluate the quality and effectiveness of online teaching.

Although the literature on evaluating the quality of online teaching is quite extensive, there is relatively limited research on specific disciplines and fields [20]. However, some scholars have conducted research on the quality of online teaching in the medical profession, proposing a set of evaluation indicators applicable to the medical field. These indicators include the level of teacher guidance, the quality and utilization of teaching resources, and student engagement. While this study is not directly applicable to the field of sports rehabilitation, it provides valuable experiences and insights for constructing the framework for evaluating the quality of online teaching in this research.

2.2. Theoretical Framework of the CIPP Evaluation Model

The CIPP educational evaluation model is an improved effectiveness-oriented evaluation model proposed by evaluation expert Stufflebeam, using appropriate theoretical frameworks to construct an indicator system for evaluating the quality of online teaching [21]. The CIPP model consists of four components: Context evaluation, Input evaluation, Process evaluation, and Product evaluation. The significance of educational evaluation using the CIPP model lies in analyzing valuable information from schools, teachers, and students' feedback, exploring key measures to improve teaching, and better serving education. Its purpose is not to prove education but to improve education. The theoretical framework based on the CIPP educational evaluation model includes four key dimensions: (1) Context evaluation, (2) Input evaluation, (3) Process evaluation, and (4) Product evaluation. This framework helps us comprehensively evaluate the quality of online teaching and understand the contextual factors, input elements, teaching processes, and learning outcomes behind it. [22-24]

2.2.1. Context Evaluation

The purpose of context evaluation is to understand the educational environment and conditions in which online teaching takes place. This includes the support and resources available in educational institutions, teaching policies and regulations, and the characteristics of students and teachers. Through context evaluation, we can understand the background and foundation of online teaching and assess the impact of these contextual factors on teaching quality.

2.2.2. Input Evaluation

Input evaluation focuses on the instructional design and teaching materials used in online teaching. This includes setting instructional goals, developing teaching plans, and selecting and designing course content, among others. Input evaluation helps us understand the teaching strategies and

resource allocation in online teaching, as well as the potential impact of these factors on learning outcomes.

2.2.3. Process Evaluation

Process evaluation focuses on the actual implementation of online teaching. It includes teachers' instructional methods and strategies, student participation and interaction, classroom organization, and management, among others. Through process evaluation, we can gain a deeper understanding of the strengths and weaknesses in the teaching process, providing targeted improvement recommendations and identifying teachers' training needs.

2.2.4. Product Evaluation

Product evaluation focuses on learning outcomes and teaching effectiveness [25]. It measures students' improvement in knowledge, skill development, and attitude changes in online teaching. Through product evaluation, we can assess the quality and effectiveness of online teaching, providing insights for teaching improvement and decision-making. Although the sudden outbreak of the COVID-19 pandemic has led to the adoption of various online teaching platforms in universities, driving significant progress in online teaching and promoting large-scale reforms, we should also recognize the limitations and challenges of online teaching as an emergency measure during this pandemic.

Compared to traditional offline teaching, online teaching utilizes new technological means more extensively, catering to the lifestyle habits of students in the information age, and making use of abundant teaching resources available on the internet to fulfill the teaching tasks during the pandemic. Generally speaking, the process of online teaching is similar to that of offline teaching, including pre-class, in-class, and post-class activities. Therefore, we can see that online teaching also meets the basic requirements of the CIPP evaluation model and follows the general principles of instruction. Through the comprehensive assessment of online teaching using the CIPP evaluation model, we can objectively measure the quality of online teaching, optimize the design of online course resources, and provide a basis for improving online teaching. This evaluation model emphasizes the evaluation of the entire process of online teaching, which includes three stages: pre-class, in-class, and post-class evaluation.

3. Construction of Indicator System

The online teaching indicators serve as an important reference for the evaluation of online teaching effectiveness by schools, experts, teachers, and students [26]. However, in recent years, there has been a limited amount of research on online teaching indicators, with most of the research focusing on indicators for traditional offline teaching. Since the process of online teaching is similar to that of offline teaching, this study draws upon indicators from offline teaching, blended learning, and flipped classrooms to establish an indicator system for online teaching.

Currently, teaching indicator systems generally fall into three categories:

1) Evaluating teaching activities as significant indicators. For example, based on the work of American scholar Robert Talbert, the pre-class stage is divided into three activities: instructional videos, communication platforms, and pre-class exercises, while the in-class stage is further broken down into six activities: posing questions, creating an environment, independent exploration, collaborative learning, communicating outcomes, and feedback evaluation, covering important steps in the flipped classroom model.
2) Setting the participants as the main reference indicators. For example, an integrated framework for inquiry-based classroom teaching indicators is established by evaluating teachers, students, and supervisors, which includes indicators for teacher classroom teaching, student classroom performance, and inquiry quality assessment.
3) Considering stages as important evaluation indicators. For example, establishing evaluation indicators for stages such as pre-class learning material, in-class teaching, and in-class teaching quality assessment.

Moreover, as the pandemic continues and online teaching becomes more widespread, the research on online teaching has gradually become more abundant. For example, starting from different levels of academic institutions, researchers study students' satisfaction with teachers during the pandemic and explore ways to improve online teaching. A comprehensive analysis of the current situation and issues faced in online teaching during the pandemic is undertaken, followed by the proposal of improvement suggestions based on the analysis. Scholars have also raised reflections on how to rationally view the development of online teaching and put forward targeted improvement recommendations. [27, 28]

Combining the general classification methods of indicator systems in the academic field and the practicality of online teaching in universities during the pandemic, the evaluation system for online teaching quality is divided into four primary indicators and fifteen secondary indicators, as shown in Table 1. It is evident that the scope of online teaching evaluation covers the entire process of online course construction and implementation, closely linking platform course resources, teaching by instructors, and the learning quality of students to ensure the comprehensive implementation of online courses. In order to verify the effectiveness of online teaching, a "Context evaluation - Input evaluation - Process evaluation - Product evaluation" model is established as an online teaching quality evaluation system.

Table 1. *Evaluation Indicator System for Online Teaching Quality.*

	Primary Indicators	**Secondary Indicators**
Evaluation Indicator System for Online	Teaching Background A	Student CognitionA1 Teacher CognitionA2

	Primary Indicators	Secondary Indicators
Teaching Quality		School PolicyA3
	Teaching Preparation (Pre-class) B	Hardware、SoftwareB1 Student Acceptance of Teaching ModeB2 Online Teaching Resources B3 Online Teaching Facilities B4
	Teaching Implementation (In-class) C	Knowledge Depth Assessment C1 Teaching Skills Assessment C2 Teaching Effectiveness Evaluation C3 Interactive Communication Evaluation C4
	Teaching Effectiveness (Post-class) D	Student Assessment Effectiveness D1 Homework Completion Evaluation D2 Student Acceptance Assessment D3 Grade Assessment D4

4. Empirical Research

Research Object The main objects of this study are the teachers involved in the online teaching of the Sports Rehabilitation Department during the second semester of the 2021-2022 academic year, as well as the university students participating in the online classes. Specifically, the online teaching course of Exercise Physiology is taken as an example.

Questionnaire Design The Likert scale was adopted in the survey, with response options ranging from 1 to 5, to facilitate later research analysis. The survey was distributed and collected via QuestionStar, with a total of 220 survey questionnaires distributed and 201 valid questionnaires retrieved. The model analysis method was utilized. Based on the questionnaire survey, and drawing on research experience, an online CIPP evaluation model was established for comprehensive analysis. The CIPP evaluation model analysis results were used to explore the issues currently existing in online teaching and propose corresponding strategies to address them.

4.1. Teaching Confirmatory Factor Analysis

Using AMOS 24.0 statistical software, a confirmatory factor analysis was conducted on an additional 100 samples to establish the online teaching quality model. The results indicated that the factor loadings and t-values in the standard model were significant and exhibited a good fit, indicating adequate convergent validity. In the confirmatory factor analysis, the fit indices, including X^2/df, CFI, TLI, NFI, RMSEA, and SRMS, were compared among different models to assess their goodness of fit. Based on scholarly analysis of the data model, the analysis included the standard model (four-factor), three-factor model 1, three-factor model 2, two-factor model, and single-factor model. The standard model comprised four factors: online teaching background, online teaching investment, online instructional implementation, and online instructional effectiveness. Three-factor model 1 merged online teaching investment and online instructional implementation into one factor, along with online instructional implementation and online instructional effectiveness as separate factors. Three-factor model 2 was similar to the standard model, but merged online teaching background with online instructional implementation into one factor, with separate factors for online teaching investment and online instructional effectiveness. The two-factor model combined online teaching background with online instructional implementation and combined online teaching investment with online instructional effectiveness, forming two factors. The single-factor model combined all four factors (online teaching background, online teaching investment, online instructional implementation, and online instructional effectiveness) into one factor. The discriminant validity of each variable was observed by comparing the models using the same dataset.

4.2. Determination of Weights for Online Teaching Quality Indicators

The weights of various indicators in the online teaching quality evaluation system are primarily based on the importance of observable variables to online teaching quality. In confirmatory factor analysis, the path loadings of observable variables represent the importance of the observable variables to their corresponding latent variables. Therefore, weights can be calculated based on the path loadings in the CFA model. The correlation coefficients in the structural equation model correspond to standardized factor loadings, which can be normalized to obtain indicator weights, as shown in the formula below, where ρ nm represents the weight of the mth indicator for the nth first-order factor. The distribution of weights for online teaching quality indicators is presented in Table 2.

$$\rho\, nm = \lambda\, nm / \sum_{i=1}^{j} \lambda\, nm$$

Table 2. *Distribution of Weights for Online Teaching Quality Indicators.*

	Primary Indicators	Weights	Secondary Indicators	Weights	Overall weights
Online			A1	0.337	0.071
Teaching	A	0.200	A2	0.334	0.070
Quality			A3	0.329	0.059

	Primary Indicators	Weights	Secondary Indicators	Weights	Overall weights
Evaluation System	B	0.330	B1	0.231	0.074
			B2	0.256	0.092
			B3	0.271	0.088
			B4	0.242	0.077
	C	0.258	C1	0.195	0.052
			C2	0.261	0.070
			C3	0.275	0.067
			C4	0.269	0.069
	D	0.212	D1	0.256	0.057
			D2	0.261	0.058
			D3	0.262	0.053
			D4	0.221	0.044
		1.000			1.000

Online teaching effectiveness = 0.200 × (Online teaching background) + 0.330 × (Online teaching investment) + 0.258 × (Online teaching implementation) + 0.212 × (Online teaching outcomes).

Online teaching background = 0. 337 × A1 + 0. 334 × A2 +0. 329 × A3

Online teaching investment = 0. 231 × B1 + 0. 256 × B2 +0. 271 × B3 +0. 242 × B4

Online teaching implementation = 0. 195 × C1 + 0. 261 × C2 +0. 275 × C3 +0. 269 × C4

Online teaching outcomes = 0. 256 × D1 + 0. 261 × D2 +0. 262 × D3 +0. 221 × D4

4.3. Online Teaching Quality Evaluation Score

Based on the calculation of online teaching, this study categorizes the online teaching quality into five levels: 0-60 points as poor, 61-70 points as fair, 71-80 points as good, 81-90 points as excellent, and 91-100 points as outstanding. Statistical analysis of the data showed that the evaluation score of online teaching quality for all participating students in the survey was 68.5 points, indicating a fair level of online teaching quality, which did not achieve a very satisfactory outcome. There is still significant room for improvement in the future.

5. Conclusion

Based on the evaluation of online teaching quality in the field of sports rehabilitation, we have summarized the following key findings:

1) Teaching background: The educational environment and conditions in online teaching are crucial for sports rehabilitation. Necessary support and resources should be provided, including professional software, practical tools, and experimental equipment.
2) Teaching investment: The design of teaching and the availability of teaching resources are crucial for the quality of online teaching in sports rehabilitation. Teachers should design targeted course content and teaching strategies based on the characteristics of sports rehabilitation.
3) Teaching implementation: During online teaching, the guidance and support from teachers, as well as the level of student participation and interaction, play a critical role in teaching quality. Teachers should use diverse teaching methods to stimulate students' interest and motivation in learning.
4) Teaching outcomes: Learning achievements and teaching effectiveness are key indicators for evaluating the quality of online teaching. The development of students' knowledge, skills, and practical abilities should be the main focus of evaluation.

6. Recommendations

Based on the above findings, we propose the following recommendations to improve the quality of online teaching in sports rehabilitation:

1) Strengthen educational support and resource investment: Educational institutions should allocate sufficient resources to provide the necessary software, hardware facilities, and practical tools for sports rehabilitation. Teachers should receive relevant training and support to master online teaching technologies and methods.
2) Design targeted teaching strategies and course content: Teachers should design specific course content for sports rehabilitation, tailored to the characteristics of online teaching. Diverse teaching strategies such as virtual experiments, case discussions, and team projects can be adopted to enhance students' learning outcomes and practical abilities.
3) Promote student participation and interaction: Teachers should encourage students to actively participate in online classroom discussions, experiments, and interactions. Group collaboration and individual reflection can facilitate mutual communication and feedback between students and teachers.
4) Introduce diverse assessment methods: In addition to traditional assignments and exams, diverse assessment methods such as practical reports, case analyses, project presentations, and peer reviews can be used to comprehensively evaluate students' learning outcomes and practical abilities.

5) Continuous improvement and feedback mechanisms: Teachers should maintain close communication with students, regularly collect feedback, and make appropriate adjustments and improvements. At the same time, educational institutions should establish effective mechanisms for quality assurance and monitoring to facilitate continuous teaching improvement and optimization.

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