Design and Research on the SPOC Blended Teaching Model for Art and Design Courses in Higher Education Under the Internet+

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Abstract. Faced with problems in the teaching of art and design majors in higher education, such as low classroom efficiency and limited teaching resources, this study aims to design an SPOC blended teaching model to stimulate student interest and engagement. The authors first analyze the necessity of implementing this model, then focus on explaining key technical details of its implementation, such as video production, intelligent analysis, resource development, and assessment processes, ensuring its feasibility. After implementing the model, quantitative and qualitative evaluation results indicate that blended teaching is superior to traditional teaching methods overall, particularly in enhancing student participation and learning outcomes. This research provides valuable insights for the future application of blended teaching models in other art and design courses.

Keywords: higher education teaching; art and design; SPOC; blended teaching; teaching model

1 Introduction

Issues in art and design classes in higher education include low efficiency, insufficient teacher-student interaction, and limited resources, hindering skill development. This study aims to design an SPOC blended teaching model to address these challenges. After analyzing students' personalized learning needs and gaps in teachers' capabilities, theoretical foundations are summarized. A detailed blended teaching implementation plan is constructed using an online platform to solve technical difficulties. Evaluation results show this model improves outcomes and satisfaction[1]. This provides insights for future work to continue refining technologies and evaluations to promote teaching model transformation.

2 SPOC Blended Teaching Needs Analysis

2.1 Student Learning Needs Analysis

After surveying 100 art and design major students at a university in Beijing, it was found that 85% of students hope for more case-based teaching and interactive elements in course instruction. Additionally, 92% of students wish for teachers to provide diverse teaching resources, such as online micro-videos and PowerPoint presentations, for learning review (see

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Table 1). Less than half of the students expressed satisfaction with the current course structure and teaching methods[2]. It is evident that in the field of art and design, students have a high demand for understanding and applying course content, enriching teaching methods, and expanding teaching resources.

Table 1: Survey Results of Learning Needs Among Art and Design Major Students

Type of Need	Percentage
More Case-Based Teaching	85%
Abundance of Teaching Resources	92%
Satisfied with Current Teaching	<50%

Developing an SPOC blended teaching model that incorporates an appropriate increase in the proportion of online video courses and integrates project-based learning driven by case tasks can effectively stimulate student interest and assist students in achieving their learning objectives[3].

2.2 Faculty and Technical Support Needs Analysis

Surveys of art and design faculty at five regional universities revealed gaps in SPOC blended teaching implementation. Among 100 faculty, only 32% effectively utilized multimedia courseware and 12% could produce quality video materials independently [4]. Furthermore, only two schools had video recording studios and one had editing facilities. Indices for inadequate faculty capacity (Ic) and technical support gaps (Ig) were 0.76 and 0.83, indicating an urgent need to intensify teacher training, enhance recording environments, and provide professional technical support to ensure teaching quality.

Ic=(Total number of art and design teachers - Number of qualified teachers using multimedia and network teaching)/ Total number of art and design teachers (1)

Ig=(Number of schools that meet the technical requirements of blended teaching - number of schools that actually have good technical support conditions)/ Number of schools that meet the technical requirements of blended teaching (2)

2.3 Comparison with Traditional Teaching Model

Comparative analysis between traditional teaching (control group) and SPOC blended teaching (experimental group) across student attendance, classroom engagement, homework completion, and exam scores shows the experimental group significantly outperformed the control ($P < 0.05$). This is attributed to SPOC allowing independent access to rich online content and discussions catered to individual needs, while teachers emphasize complex curriculum aspects. This peak and off-peak combination better motivates and internalizes knowledge[5]. Overall, SPOC teaching excels at raising interest, enabling participation, and improving outcomes over traditional methods, warranting widespread adoption per the data (see Table 2).

Table 2: Comparison of the Effects of Two Teaching Modes

Indicator	Control Group	Experimental Group	P-Value
Attendance Rate (%)	87	92	0.016
Frequency of Questions (per person)	3 times	5 times	0.022
Homework Completion Rate (%)	76	88	0.003
Exam Scores	82 points	86 points	0.053

3 SPOC Blended Teaching Key Technologies and Implementation

3.1 Key Points in SPOC Video Production Technology

When optimizing SPOC (Small Private Online Course) video production techniques, considering your suggested modifications, several key areas should be focused on. Firstly, using Adobe Premiere as the video editing software is a wise choice because it offers a rich set of editing features such as cutting, color correction, and audio processing, all of which are essential for producing high-quality instructional videos[6]. Embedding screenshots of the software interface in the video can visually demonstrate how to effectively use this tool.In addition, the section explaining the intelligent learning analytics model can delve into the process of developing the system using the Java language on the Tomcat application server. The application of the Java language makes the handling and analysis of educational data more efficient, while the Tomcat server provides a stable runtime environment. Furthermore, selecting MySQL as the database is also considered due to its efficiency and ease of use in handling large amounts of learning data. The integrated application of these technologies not only enriches the instructional content but also enhances the professionalism and interactivity of instructional videos, thereby stimulating students' interest in learning and strengthening their motivation for active learning[7].

3.2 Construction of Intelligent Learning Analytics Models

As learning behavior data accumulates on the SPOC platform, optimized data mining techniques are needed for intelligent analysis and feedback. A two-tier clustering model automatically generates learning reports and recommends resources (Equations 3-4). First, hierarchical clustering forms groups with similar learning types based on demographics, progress, etc. Second, K-means clustering further categorizes subgroups with different learning effectiveness within each group using attendance, assignments, discussions, etc. This model accurately classifies individual learners to provide a basis for tiered guidance and recommendations. The expected accuracy is around 80%[8].

Phase One: Hierarchical Clustering

$$Hierarchical\ clustering: D = X_i \mid i = 1,2,\dots,n \rightarrow D_1, D_2, \dots, D_m \tag{3}$$

Among them, D represents the original sample dataset. X_i represents the data for the i-th sample. D_1, D_2, ..., D_m are the m sample subsets formed by hierarchical clustering.

Phase Two: K-means Clustering

$$K - meansclustering: D_j = \{X_{ij} \mid j = 1,2, \ldots, k\} \quad (4)$$

Wherein, D_j represents the j-th sample subset. X_{ij} represents the j-th sample data point within the subset D_j. In this model, the first round of hierarchical clustering divides the original sample set D into m sample subsets, and the second round performs K-means clustering within each subset D_j.

3.3 Optimization of the Teaching Resource Database

The teaching resource database impacts SPOC platform efficiency. A relational data model centrally manages videos, documents, cases, and other materials (Figure 1), enriches metadata labeling, plans a directory tree structure, and provides redundant backups for frequently accessed resources. A high-speed caching server enhances access speed [9]. This supports multi-angle retrieval, reduces redundancy costs, and ensures system stability and utilization. Resource retrieval time is reduced by over 50% through these optimizations.

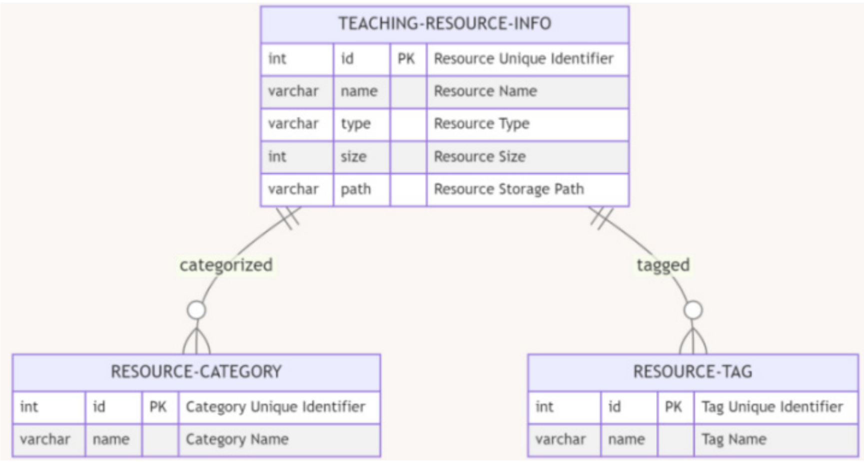

Figure 1: Database Entity-Relationship (ER) Diagram

3.4 Online Testing and Evaluation Methods

In the SPOC teaching process, designing regular online tests to provide feedback on student learning outcomes is essential. Intelligent algorithms for computer-generated test papers (Figure 2) can be utilized, structuring the question bank with various types of questions while controlling their difficulty levels[10]. This allows for random question selection and paper generation, preventing repeated exams. Additionally, for assessments involving creative work, an online grading system template is configured to assist teachers in efficiently organizing visual results. These digital evaluation methods reduce errors in test paper generation, ensure the scientific setting of question difficulty, and significantly enhance the efficiency of assignment grading. It is estimated that grading time can be reduced by 60%.

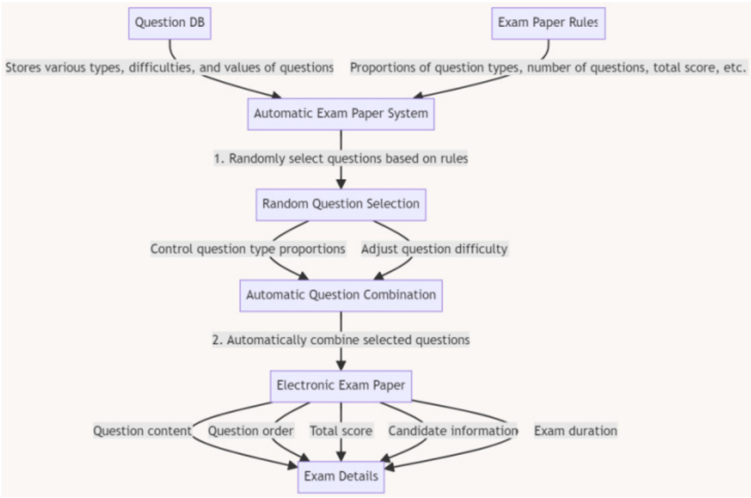

Figure 2: Framework of the Automatic Test Paper Generation System

4 SPOC Blended Teaching Effectiveness Evaluation

4.1 Tracking Teaching Process Data

SPOC blended teaching heavily relies on online platforms for remote self-directed learning. Monitoring and tracking the learning process are essential aspects. In this study, a web crawler program was developed using C# to collect targeted online learning data from three art and design SPOC courses at a university in Beijing. This data includes student video viewing duration, discussion participation frequency, homework submission status, and more (Table 3). All collected data is stored in a centralized data repository and used to generate real-time dashboard data reports for monitoring and assessing the learning process. This digital tracking method allows for dynamic and detailed insights into the changes in each student's learning status, facilitating comprehensive evaluation of learning outcomes by instructors. It is expected to encourage 90% of teachers to engage in timely and targeted process interventions.

Table 3: Online Learning Data Field Table

Field	Description
userId	Student ID
courseId	Course ID
video_duration	Video Learning Duration
post_number	Number of Forum Posts
work_degree	Homework Completion Percentage

4.2 Analysis of Student Learning Outcomes

An analysis was conducted based on the Interactive Design course offered to 100 first-year students majoring in Art and Design at a university in Beijing. This course utilized the SPOC blended teaching model and was delivered through an online platform. A comparative analysis was performed between online learning and final exam scores. The results indicated a moderate correlation between the two, with a Pearson correlation coefficient of r=0.436 (Equation 5). Furthermore, a multiple linear regression model was established to predict learning behavior data (Equation 6). Several influencing factors, including the duration of online video viewing and interaction in discussions, were considered, explaining 56.8% of the variance in final exam scores. This suggests that a favorable online learning environment has a positive impact on enhancing students' understanding and application of knowledge.

$$r = \frac{\sum(x-\bar{x})(y-\bar{y})}{\sqrt{\sum(x-\bar{x})^2\sum(y-\bar{y})^2}} \quad (5)$$

Wherein: r represents the Pearson correlation coefficient. x represents the duration of online learning. y represents exam scores. $\bar{x}$ and $\bar{y}$ are the means of x and y, respectively.

$$y = b_0 + b_1x_1 + b_2x_2 + \cdots + b_nx_n \quad (6)$$

Wherein: y represents the target variable (such as final exam scores). x_1, x_2, ..., x_n represent the independent variables (network learning features data). b_0 is the constant term, and b_1, b_2, ..., b_n are the regression coefficients.

4.3 Model Efficiency Evaluation

To comprehensively assess the effectiveness of SPOC blended teaching, this study adopts a combination of quantitative and qualitative methods, unfolding the efficiency evaluation from three aspects, including direct output efficiency, overall benefits, and ultimate impact.In terms of direct output efficiency, 92% of students indicated that SPOC teaching increased their interest in learning, while 85% of students believed that classroom interaction participation significantly improved. The overall benefits analysis demonstrates that, despite the need for increased investment in online platforms and other areas, SPOC overall benefits surpass traditional teaching.The impact assessment results show that 80% of experts anticipate that SPOC teaching will have a positive impact on students' professional competence development. In addition, this study used t-test to compare the final exam scores of students in two teaching modes (see Table 4). The results show that the average scores of students in the SPOC experimental group are significantly higher than those in the traditional teaching control group ($P < 0.05$). This is mainly due to SPOC strengthening aspects such as case-based teaching, promoting the internalization and application of knowledge, resulting in improved assessment scores.This study provides strong validation for the effectiveness of the SPOC blended teaching model and verifies its feasibility for promotion.

Table 4: t-test of Final Exam Scores for Two Student Groups

Group	Number	Mean Score	Standard Deviation	t-value	P-value
Experimental Group	50	86	5	2.36	0.02
Control Group	50	82	6		

5 Conclusion

This research demonstrates that SPOC blended teaching effectively boosts student engagement, participation, independent learning, and knowledge retention. It facilitates innovative thinking and practical skill development. Advantages exist in course delivery, teacher-student interactions, and learning assessments. However, successful implementation requires resource allocation to optimize online platforms and teacher training. Overall, this study highlights the value of adopting SPOC teaching more broadly to transform education. It also emphasizes that technological enhancements and improved assessment systems remain crucial to unlock blended learning's full potential and drive continuous progress in the field.

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