Research on Design and Construction of Learning Cyberspace Based on PST Framework in Higher Education

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Abstract. Great changes have occurred in the relationship between teaching and learning, as well as the means of transmitting and receiving knowledge, as a result of the ongoing growth and in-depth application of information technology, as well as the influence of the COVID-19 epidemic. Blended learning is widely employed in college and university classroom instruction. Higher standards for teaching and learning activities are proposed to support more functions and services in learning cyberspace. This article describes the changes in teaching and learning brought about by information technology, then improves the PST framework and offers the Pedagogy-Space-Technology-Resource-Service (PST-RS) element model for the development of learning cyberspace. It outlines the goals, principles, and key points for mastering cyberspace construction based on this model. Finally, using the blended learning mode "Flipped Classroom" as an example, it explores the instruction methods based on learning cyberspace as a reference for investigating the reform of teaching and learning modes in colleges and universities.

Keywords: learning cyberspace · PST framework · blended learning · flipped classroom

1 Introduction

With the constant advancement of information technology, new teaching and learning methods arise in an endless stream, dramatically impacting higher education teaching theories, models, and learning environments. The continual maturation and use of cloud computing, big data, and the next generation of artificial intelligence technology, in particular, are sure to have a significant impact on the teaching model, learning methods, and even the educational form of colleges and universities. Furthermore, the global COVID-19 pandemic in 2020 has influenced, transformed, and even redefined the way people live, work, and study, making online learning and remote work the new normal. Blended learning and flipped learning have become the primary instructional methods used in college and university classrooms. According to the 2022 EDUCAUSE Horizon Report: Teaching and Learning Edition, blended learning and online learning will become the

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mainstream model of teaching and learning in the future [1]. The emphasis on information technology in education is growing beyond the development of learning spaces to incorporate factors other than hardware, software, and the network. In this context, the learning cyberspace, which is the key support platform for blended learning, must also be adjusted in terms of framework, structure, function, and service to conform to the development trend and demand of "Internet + Education".

2 Teaching and Learning Changes Under Information Technology

The growth of information technology has resulted in a shift in teaching and learning strategies, with more and more modern instructional methods being used in traditional classroom teaching and learning activities. According to the current trend in educational development, needs for teaching and learning have changed, and new teaching modes such as blended learning, mobile learning, and flipped learning with fragmented and interactive features have emerged, gradually forming a new form of teaching and learning aimed at increasing student motivation and supporting their learning strategies [2].

2.1 Changes in Teaching and Learning Modes

The present manner of teaching and learning has shifted from teachers just delivering knowledge to students (Teacher-centered) to teachers guiding students to carry out personal exploratory learning (Student-centered). The student-centered instruction mode will be the primary mode of education in the classroom, combining traditional face-to-face classroom instruction with online learning. First, classroom instruction has altered, with less time spent in class by professors teaching knowledge and more time spent by students learning independently, discussing, communicating, and sharing outcomes. Teachers focus on the cultivation of students' learning abilities and innovation abilities by carrying out teaching and learning activities using flipped learning, collaborative learning, PBL, and other learning models based on information technology. Second, greater emphasis is being placed on the coherence and cohesion of learning activities, the coherence of the learning process inside and outside the classroom, the integration of teaching and learning resources both online and offline, and the integration of teaching procedures such as "before class", "during class", and "after class", thereby breaking down time, space, and regional barriers. Third, concentrating on the use of smart instruction technologies, teachers gather and evaluate teaching and learning data to provide students with diverse and tailored learning services.

2.2 Changes in Teaching and Learning Evaluation Methods

The mode of teaching and learning influences the method of teaching and learning evaluation, and learning evaluation has gradually shifted from the result evaluation of students' learning effects to the process evaluation of their entire learning process. Using big data mining technology, records of teachers' teaching processes and students' learning processes are collected online and offline, in-class and out-of-class, in order to accurately analyze and evaluate teaching and learning activities.

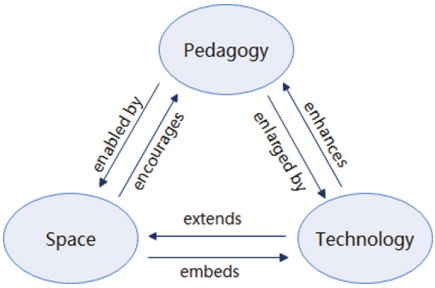

Fig. 1. Radcliffe's PST framework [Owner-draw]

2.3 Changes in Teaching and Learning Space

The shift in teaching and learning modes has had an impact on the teaching and learning space, which serves as a vital conduit for teachers to conduct teaching and learning activities. Space has evolved from a purely physical environment to an integrated teaching and learning environment that incorporates physical space, network space, and social space [3]. Modern information technology can be used to provide teachers with appropriate resources and instructional means, stimulate students' learning interests, and promote students' learning efficiency [4]. First, based on physical space, teaching and learning space integrates functions and services of online space, virtual learning community, collaborative work platform, instruction management platform, and technical service platform to realize the integration of space, technology, resources, and learning tools, as well as to expand the teaching and learning application scene of space. Second, the teaching and learning space is infused with various educational and instructional services that traditional space forms cannot offer, and learners are provided with appropriate learning materials, tools, scaffolding, and other services. Third, in the teaching and learning space, artificial intelligence technology can be used to deliver accurate learning analysis based on comprehensive data of the instructional process to assist students in improving the efficiency of their individual studies.

3 Design of Learning Cyberspace Model Based on PST Framework

3.1 PST Framework

The Pedagogy-Space-Technology (PST)framework was pioneered by Radcliffe Professor of the University of Queensland. It offered fresh, useful suggestions for the development of various teaching and learning spaces [5]. As shown in Fig. 1, the PST framework model has three components: pedagogy, space, and technology, technology in this context refers to information technology in the context of the current instructional situation.

Pedagogy guides the design and implementation of the combination of information technology and learning space. Learning space incorporates information technology and promotes pedagogical application, whereas information technology improves pedagogical implementation and broadens the scope of learning space. The integration of

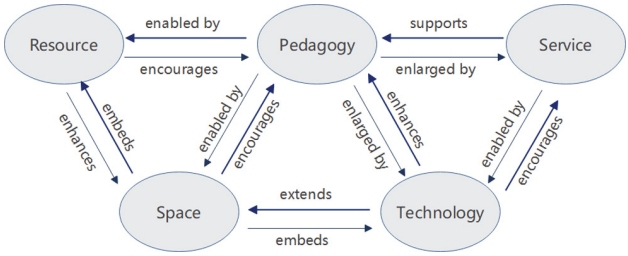

Fig. 2. PST-RS element model of learning cyberspace [Owner-draw]

pedagogy, learning space, and information technology to improve the learning environment is the PST framework's key innovation. The PST framework is significant in that it treats the relationship between teaching, learning space, and information technology as an organic whole rather than as separate elements. All space designs are based on enabling students to improve their learning experience and achieve the best learning outcomes, which is one of the reasons we chose the PST framework to construct learning cyberspace.

3.2 Design of Element Model of Learning Cyberspace

The learning cyberspace element model serves as the theoretical foundation for building the learning cyberspace, and the PST framework serves as a basic framework for designing learning spaces that must be updated and modified in response to unique research problems [6]. This study highlights the features of teaching and learning activities under the new situation of education digital transformation, adds two elements of resources and services, and constructs and proposes the Pedagogy-Space-Technology-Resource-Service (PST-RS) model based on the PST framework. The specific design concept is based on combining physical space, virtual space, and social space, as well as advanced information technology and the use of rich digital teaching resources, to create a new integrated, collaborative, interactive, and shared learning environment, as shown in Fig. 2.

Pedagogy is the foundation of learning in cyberspace. Varied teaching methods and learning strategies must be used in the classroom for different teaching objectives and learning resources. Learning cyberspace should include many features and services that are ideal for a wide range of teaching and learning forms, as well as the ability to promote the growth of various instructional approaches such as cooperation, discussion, and inquiry-based learning.

Technology, particularly information technology, determines the building and application level of learning cyberspace, which influences the kinds of instructive interactions, learning resource supply, and learning assessment methods. Artificial intelligence and other modern technologies can assist teachers and students in carrying out teaching and learning activities based on new instruction modes in cyberspace. Using information technology to conduct data analysis on many factors impacting the quality of classroom instruction and to provide information services for the entire teaching and learning process.

Resources serve as the foundation for teaching and learning activities. Digital textbooks, course videos, exercises, courseware, and multimedia learning tools are examples of teaching and learning resources. Teaching and learning resources must be reusable, quickly obtained, regularly updated, adapt to the needs of diverse learners, and easily applied to various teaching and learning activities via learning cyberspace.

Service is a collection of activities that supplement teaching and learning. Service types include information service, resource service, personnel service, facility service, instructional service, and so on [7]. The goal of instructional services is to carry out teaching and learning activities for teachers and students while also offering management, teaching, learning, and technological assistance.

Space transports teaching and learning activities. Space blends technical tools, instructional resources, as well as teaching and learning services to provide closed-loop instruction assistance with three sections for distinct teaching and learning activities: "before class", "during class", and "after class". Space can support blended learning in a variety of ways, including teaching resources, instructional methods, technical tools, and service models.

4 Construction and Application of Learning Cyberspace Based on PST-RS Model

4.1 Construction of Learning Cyberspace

Learning Cyberspace based on the PST-RS model is a hybrid area that learners can access at any time and from any location. It should organically integrate technology, space, resources, instructional methods, and services to create a comprehensive teaching and learning service platform that utilizes the existing environment, equipment, and systems in colleges and universities to provide comprehensive and systematic education and instruction services.

In the digital age, learning cyberspace must be able to fully utilize advanced information technology, build and provide resource sharing, instruction support, learning interaction, decision evaluation, and data analysis functions, provide diverse content display and instruction methods to teachers and students, and meet the needs of personalized learning for different groups of people.

The practice of analyzing teaching and learning activities is known as learning analytics. Learning analytics is included as one of the leading technologies and practices that will have a big impact on the future of teaching and learning in the 2022 EDUCAUSE Horizon Report: Teaching and Learning Edition. Learning analytics is the collection and analysis of teaching and learning data, the use of data to analyze the learning process, the implementation of appropriate measures to improve students' learning experiences based on the analysis results, and the provision of solutions for optimizing the learning environment [8]. Learning analytics based on big data and artificial intelligence can give technical model and algorithm support for the development of learning cyberspace, as well as more methodologies and approaches for the development of smart education and the implementation of creative instructional modes.

Several critical issues should be understood when using learning analytics apps in learning cyberspaces: First, acknowledge the significance of data. Data are objective

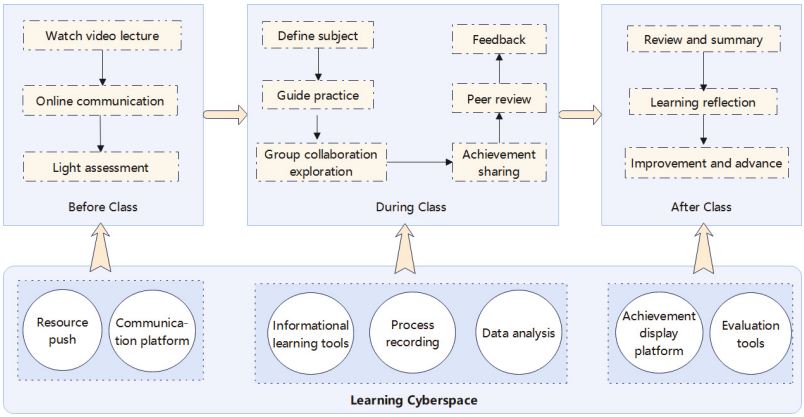

Fig. 3. Instruction processes of "flipped classroom" with learning cyberspace [Owner-draw]

occurrences recorded during the teaching and learning process in instruction. Learning analytics is the study of what happens during the teaching and learning process to offer a firm foundation for intervention actions. Second, learning analytics should focus on curriculum statistics, teaching and learning behavior analysis, instruction assessment, and students' learning warning as the core, organizing and analyzing data using artificial intelligence technology. Third, the design of learning analytics models and algorithms should be based on real-world teaching and learning requirements, and the choice of learning analytics model parameters, forms, and application techniques should be based on the learning cyberspace. Lack of attention and evaluation of the learning cyberspace application mode will lower the accuracy and validity of the model prediction value.

Furthermore, learning cyberspace should make full use of artificial intelligence technology, develop teaching and learning tools based on artificial intelligence, guide learners through automated models to complete learning tasks, promote interaction between learners and learning tools, and improve learning efficiency and effectiveness.

4.2 General Application Modes of Learning Cyberspace

Learning cyberspace application is a type of blended learning that utilizes learning cyberspace to carry out collaborative and inquiry-based learning on the issues of boosting learners' learning interests and enhancing their learning efficiency. The application of learning cyberspace has a comprehensive instruction procedure that is divided into three sections: before class, during class, and after class [9]. Taking "flipped classroom" as an example, the instruction process of blended learning is shown in Fig. 3.

Teachers use learning cyberspace before class to complete the preparation of online learning resources such as video lectures, courseware, and quizzes. Students are required to watch the video lecture before class and to put their learning to the test with exercises and quizzes. If students have any questions, they can engage in online dialogue and discussion to accomplish independent and individualized learning. Students use tutorials, quizzes, and assignments to improve knowledge transfer and internalization.

Teachers must summarize and offer some topics of inquiry value in class based on course content and responses from students' learning situations before class. Students select the appropriate inquiry topic based on their goals and interests. During this procedure, the teacher helps students with a targeted topic selection and organizes them to undertake independent exploration, division of labor, and collaboration, then students finalize individual or group results based on independent research and collaborative learning. Finally, students must present and report on their achievements in the classroom, as well as discuss and exchange their learning experiences in the production of work. Teachers and students collaborate, communicate, share, and use other methods to accomplish secondary internalization of knowledge through interactive teaching and learning.

Students work with teachers after class to synthesize the learning effect and consolidate their knowledge. Students should take in-class notes on their learning summaries, investigate the entire learning process in and out of class, record learning impressions, and make instructional improvement ideas so that students' knowledge can be assimilated for the third time [10].

Learning cyberspace can provide a variety of functionalities and service support for "flipped classroom" activities in the preceding instruction process. Before class, learners use the "resource push" and "online communication" functionalities in the learning cyberspace to acquire relevant resources and answers to simple inquiries. Various "informational learning tools" are available in class for teachers and students. The "process recording" and "data analysis" functions are used to assist learners with monitoring, process recording, and real-time feedback on classroom exercises. After class, use an innovative "achievements display platform" and "assessment tools" to exhibit and remark on learners' work, as well as reflect on and summarize learning outcomes.

5 Conclusion

As the blended learning concept becomes more popular in higher education classrooms, learning cyberspace will take on additional support and service functions for blended learning. Strategic use of information technology can improve learner engagement, access, and service convenience. The learning cyberspace design based on the PST framework intends to investigate the development of a new instructional environment that makes extensive use of instructional methods, information technologies, resources, and services to reform and improve the teaching and learning space. Learning cyberspace will continue to evolve in terms of aggregating resources, data analysis, intelligent evaluation, personalized management and services, and bringing together and integrating various space-oriented micro-service applications to solve the problem of openness and connectivity for teaching and learning, and for teachers, learners, education managers, and other stakeholders to provide personalized services to meet current education and instruction needs.

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References

1. EDUCAUSE, (2022). 2022 EDUCAUSE Horizon Report: Teaching and learning edition. https://library.educause.edu/resources/2022/4/2022-educause-horizon-report-teaching-and-learning-edition.
2. Ying Yu, Wenwen Chen, (2018). The analysis of advanced development of smart classroom teaching model. China Educational Technology, 11,126-132.
3. Guohui Zhan, Tao Liu, Fenyuan Dai, (2022). AI-driven integration of intelligent teaching space in colleges. Journal of Ningbo University (Educational Science Edition), 44(03),66-74.
4. Xiaowen Li, Weijian Ye, (2020). On the space dimension of the transformation of classroom teaching paradigm. Jiangsu Higher Education, 01,88-93.
5. Radcliffe D, (2008). A Pedagogy-Space-Technology (PST) framework for designing and evaluating learning places. Proceedings of the Next Generation Learning Spaces Colloquium. Brisbane: The University of Queensland, 9–16.
6. Zhen Li, Dongdai Zhou, Shaochun Zhong, et al, (2016). Research on personalized web learning space based on cloud computing. Modern Educational Technology, 26(11),114-120.
7. Xingfu Ding, (2002). On student learning support service in Distance Education: Part 2. China Educational Technology, 04,55-59.
8. Dragan Gaševi'c, Zhichao Wu, Sixu Lu, et al, (2022). Artificial intelligence and learning analytics for the future. Chinese Journal of ICT in Education, 28(03),5-12.
9. Yubao Yang, Lihong Wu, (2016). The innovative application model of network learning space from the perspective of ubiquitous learning. China Educational Technology, 07,29–35+42.
10. Mei Rong, Xuehong Peng, (2015). A study on the history, current situation and application of "Flipped Classroom". China Educational Technology, 07,108-115.