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Research on Interface Design Optimization of Online Learning Platforms for Universities Based on Cognitive Load Theory

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Abstract

Against the backdrop of deepening digital transformation in education, online teaching platforms have gradually become an important carrier connecting online and offline teaching. The interface design of university learning platforms significantly influences the distribution and regulation of cognitive load during the learning process, thus having a significant impact on learning efficiency and effectiveness. This paper, based on cognitive load theory, studies the interface design of university learning platforms. It analyzes the key design aspects affecting students' cognitive load, as well as the shortcomings of current interface design, explores the intrinsic relationship between interface characteristics and cognitive load, and proposes corresponding optimization strategies, providing theoretical and practical references for the optimization and upgrading of university learning platforms.

Keywords

Cognitive load; university learning platform; interface design; learning efficiency

1. Introduction

With the continuous application and development of information technology in higher education, digital teaching tools are gradually being integrated into all aspects of university teaching. Oproiu (2015) believes that although it is unable to replace traditional education, the internet creates new teaching-learning-assessment approaches. The information acquired this way, the convenience of its use, enables e-learning to serve as a supplement and continuation of traditional education.The functionality and user-friendliness of university learning platforms have become core factors influencing teaching quality. Unlike ordinary commercial application interfaces, the core value of university learning platforms lies in assisting learning activities, and the rationality of their interface design is related to the learner's cognitive state—both excessively high and low cognitive loads will affect learning behavior and efficiency.

Working memory plays a crucial role in the learning and cognitive process, and its functional performance often affects learners' ability to process information.Some scholars have pointed out that working memory has a limited capacity. When the target information in the learning environment is too abundant or presented in an inappropriate way, it can easily overload the learner's working memory, affecting the learner's cognitive processing (Gao et al., 2017).Currently, some university learning platforms suffer from problems such as chaotic interface layout, redundant information, and cumbersome interaction logic. This forces learners to invest a lot of cognitive resources in processing irrelevant information. For example, the text layout is too dense, and there is no clear distinction between the main knowledge points and secondary content. Video explanations also include too many images, animations, or background elements that are not closely related to the teaching content, all of which increase the difficulty for learners to filter and process effective information.

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2. Cognitive Load Theory and Interface Design of University Learning Platforms

2.1. Core Connotation and Classification of Cognitive Load Theory

Sweller (2010) identifies three types of cognitive load: intrinsic cognitive load, which is related to the inherent complexity of information; extraneous cognitive load, which is associated with instructional design methods; and germane cognitive load, which is related to knowledge acquisition.Intrinsic cognitive load is determined by the degree of interaction between the elements of the learning task and the learner's prior knowledge level; it is an inherent cognitive consumption of the learning activity. Extraneous cognitive load, also known as irrelevant cognitive load, mainly stems from inappropriate interface design, information organization methods, or learning environment factors. Excessive extraneous cognitive load consumes limited working memory resources, thus interfering with effective learning.Germane cognitive load refers to the cognitive resources learners invest in actively constructing knowledge structures and deepening their understanding, which helps in the internalization and transfer of knowledge.Some scholars argue that the three types of cognitive load are cumulative. Extraneous cognitive load is unrelated to knowledge construction and should be minimized, whereas intrinsic and germane cognitive load contribute to knowledge construction and should be prioritized (Si et al., 2013).The interface design of online learning platforms for universities should be geared towards reducing external cognitive load, minimizing irrelevant information interference and unnecessary operational steps. By optimizing interaction design and information presentation methods, learners can be encouraged to allocate more cognitive resources to knowledge comprehension and mastery.

2.2. The Relationship Between Interface Design and Learning Cognition of University

Learning Platforms The interface design of university learning platforms mainly includes four aspects: first, visual design, such as color, font, and icon design; second, navigation design, including menu structure, path guidance, and return methods, which determines students' sense of location and operational continuity within the platform; third, information design, namely the organization and presentation of learning content. These design elements all affect students' comprehension process and user experience; and fourth, interaction design, mainly referring to whether the operation process is simple and whether feedback is timely.

Unlike ordinary commercial platforms, university learning platforms not only need to be fully functional but also conform to teaching principles and students' cognitive habits. If the interface design is unreasonable, students may expend too much energy searching for functions, understanding information, or completing operations, thus affecting learning efficiency. Therefore, the interface design of university learning platforms should, while meeting teaching needs, minimize students' cognitive burden and achieve a balance between practicality and ease of use.

2.3. Analysis of Cognitive Load Issues in the Interface Design of University Learning Platforms

Based on the current application status of some university learning platforms, the problems leading to cognitive load imbalance in interface design mainly focus on four aspects: First, unreasonable visual design. Some learning platforms use too much color, have inconsistent interface styles, and lack standardized fonts and icons, easily distracting students. Second, in terms of navigation design, some platforms have complex navigation structures, scattered function entrances, and excessively deep hierarchies, affecting students' ability to quickly locate learning content. Third, inappropriate information presentation. For example, some

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learning platforms lack clear hierarchical distinctions in the display of course resources, assignment requirements, and teaching notices, and key information is not highlighted enough. Fourth, cumbersome interaction design. Some platforms have complex operation processes, and functional feedback is not timely or clear enough. This causes students to spend a lot of energy dealing with the interface itself rather than focusing on the learning content.

3. Optimization Strategies for University Learning Platform Interface Design Based on Cognitive Load Theory

3.1. Interface Organization Strategy Based on Learning Tasks

From a cognitive load perspective, the interface organization of university learning platforms should be centered on learning tasks, rather than simply piling up functions. Platform design needs to rationally plan the content presented on the interface around key student activities in the learning process, such as course learning, attendance, participation in tests, and obtaining feedback, avoiding irrelevant functions that might distract students.Vlasenko et al. (2023) argue that the criterion of visual design is an important component in evaluating the interface of any information system. It covers aspects such as readability, aesthetic design, the quality of template structure and typography, and the logical organization of information on educational platforms.In the design of online learning platforms for universities, tasks closely related to the current learning stage can be placed in prominent positions on the interface, enabling students to quickly locate the learning content they need to complete after logging into the platform. By organizing the interface around learning tasks, it helps guide students to concentrate their limited cognitive energy on core learning activities, thereby reducing the external cognitive load caused by irrelevant information.

3.2. Focusing on Smooth Interface Navigation Strategies

A clear operational path is a crucial prerequisite for reducing cognitive burden. University learning platforms should prioritize simplicity and directional clarity in their interface design, avoiding complex and lengthy processes that disrupt the learning rhythm. For example, in online exam scenarios, if students need to repeatedly switch between multiple pages to access the exam interface, or struggle to quickly find the exam entry point before the exam begins, they are prone to anxiety and confusion, thus increasing their cognitive burden.

In interface design, the access hierarchy of core learning functions should be controlled to minimize unnecessary page jumps. Taking online exams as an example, a clear and prominent "Enter Exam" entry point can be set on the course homepage or exam notification page, reducing the number of steps students need to take before the exam. A clear navigation bar and a back button help students easily confirm their current location and familiarize themselves with the platform's operation, avoiding repeated judgment and fumbling during use. Clear interface guidance helps reduce the judgment cost for learners during operation, making the entire learning and usage process smoother.

3.3. Information Presentation Strategies Focusing on Comprehension Efficiency

The way information is presented affects learners' comprehension efficiency and cognitive load. University learning platforms should avoid information overload and disordered presentation. They should guide learners to quickly identify key information through reasonable hierarchical division and highlighting of key points. For example, in the presentation of course content, assignment instructions, and learning tips, methods such as title prompts, different font sizes, and appropriate white space can be used to highlight key information and downplay secondary information. At the same time, combining textual explanations with charts, lists, and other

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formats helps reduce the difficulty of information comprehension and decreases the cognitive consumption learners experience during information filtering and processing.

3.4. Relying on a consistent interface interaction strategy

Interface design should leverage appropriate interaction design to maintain consistency in the operational logic of different functions, helping learners gradually develop stable operational expectations and usage habits, and reducing the cognitive burden when switching between different functions. Luo et al. (2013) argue that a user-friendly interface allows learners to clearly understand the core content, making it easy for them to become familiar with the functions and use them conveniently.When designing university teaching platforms, consideration should be given to unifying button styles, operational flows, and feedback and prompt methods at the interaction level to ensure that similar operations have consistent interactive representations across different pages.

At the same time, interaction design should emphasize the timeliness and clarity of operation feedback, so that learners can quickly confirm the system response after completing operations such as clicking, submitting or switching, and avoid repeated operations or operation interruptions due to unclear feedback.Improving the coherence of the interaction process and the clarity of feedback information helps reduce ineffective cognitive consumption and provides stable support for the smooth conduct of learning activities.

4. Conclusion

Cognitive load theory provides theoretical support for optimizing platform user experience. The design of the platform interface, including visual presentation, navigation, and information display, affects students' cognitive state during use, thus impacting their learning experience and learning outcomes. Currently, some university learning platforms still have shortcomings in interface design, easily causing students to expend excessive energy during operation and comprehension, potentially affecting their engagement with learning content and thus hindering the platform's teaching functions. The interface optimization strategies proposed in this paper are intended to provide a reference for optimizing the functions and improving the interface design of university learning platforms.

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