

Research Article

Research on Deep Learning Strategies Based on Online Courses

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Abstract

The development of current online courses increasingly emphasizes practical application and learning outcomes. Deep learning serves as a core strategy for effectively addressing the inherent challenges of online education and fostering students' higher-order cognitive abilities. Deep learning aims to cultivate advanced critical thinking, with its necessity arising from the need to analyze and solve complex problems. It is characterized by the following features: a deep engagement with the learning context, which can be transferred and applied to address novel and complex problems; an emphasis on the integration and construction of knowledge to generate new understanding and cognitive frameworks; a reliance on critical thinking grounded in comprehension; and an intrinsic motivation derived from self-directed and active learning driven by personal needs and goals. The exploration of approaches and strategies for implementing deep learning in online courses will constitute a central and challenging focus for future research in online education. To establish an effective deep learning framework within online courses, attention should be given to the dynamic development of deep learning resources, the design of instruction centered on knowledge construction and transfer, the collaborative development of presence within deep learning virtual communities, encompassing teaching presence, social presence, and cognitive presence, and further explore the multi-dimensional and full-process evaluation behaviors associated with deep learning.

Keywords

Online Courses, Deep Learning, Critical Thinking

1. The Development of the Concept of Deep Learning in the Field of Education

Deep learning originated from research on artificial neural networks and represents a form of machine learning that involves multi-layered hidden structures within neural networks. It is a progressive process that moves from lower-level to higher-level understanding and from specific instances to abstract concepts through data-driven methodologies [1]. In the field of education, Ference Marton and Roger

Saljo first introduced the concepts of deep learning and surface learning in their 1976 article titled "Approaches to Learning." They categorized learners into deep-level processors and surface-level processors based on their approaches to acquiring and processing information [2]. In 2012, the National Research Council (NRC) of the United States published a special report entitled "Education for Life and Work:

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Developing Transferable Knowledge and Skills for the 21st Century," in which deep learning was defined as the process through which learners can apply previously acquired knowledge to novel learning contexts—commonly referred to as transfer [3]. Professor Zhu Zhiting synthesized the perspectives of the NRC and the Hewlett Foundation, proposing that deep learning encompasses three core domains: cognitive, intrapersonal, and interpersonal. These domains incorporate six key competencies: mastery of core academic content, critical thinking and complex problem-solving skills, the ability to learn how to learn, the capacity to develop and sustain academic motivation, collaborative teamwork abilities, and effective communication skills [4]. Professors He Ling and Li Jiahou define deep learning as a process in which learners, building upon prior understanding, critically engage with new ideas and facts, integrate them into existing cognitive frameworks, establish connections among various concepts, transfer knowledge to new contexts, and make informed decisions to address problems [5]. By highlighting the limitations of current shallow learning approaches, Professor An Fuhai examines the importance of shifting pedagogical focus toward deep learning in the context of the artificial intelligence era. He further explores the rationale behind such a shift and proposes that fostering deep learning can enhance students' ability to apply knowledge, thereby demonstrating its practical significance in educational design [6].

2. Characteristics of Deep Learning in the Field of Education

Deep learning aims to cultivate higher-order thinking skills. Its necessity arises from the need to analyze and solve complex problems. It is characterized by knowledge transfer and application, integration and construction, critical understanding, and active learning.

2.1. Deep Engagement with the Learning Context and Its Practical Application

Transfer and application require learners to develop a deep understanding of the learning context, identify key elements, and apply them to different situations through analysis and judgment. Learners apply theoretical principles and conceptual ideas to novel problem scenarios to address unfamiliar challenges. When existing knowledge proves insufficient for solving complex new problems, learners engage in further analysis and critical judgment to facilitate meaningful knowledge transfer and generate innovative solutions.

2.2. Deep Learning Emphasizes the Integration and Construction of Cognitive Knowledge

This involves integrating new knowledge with prior

knowledge, synthesizing insights across multiple disciplines, and connecting new information with existing cognitive frameworks. Through this process, learners incorporate new knowledge into their existing knowledge structures, leading to the formation of new understandings and the reconstruction of their cognitive systems.

2.3. Critical Understanding Is a Core Component of Deep Learning

Unlike rote memorization, deep learning involves a critical and reflective approach to knowledge acquisition. It encourages learners to question, analyze, evaluate, and apply information thoughtfully. Deep learners engage in critical inquiry, examining learning materials with a questioning mindset, identifying relationships among different perspectives, and developing a deeper comprehension of complex concepts [7].

2.4. Active Learning Serves as the Intrinsic Motivation in Deep Learning

Deep learning is a self-directed and intentional cognitive process. While surface learning may also involve diligence and focus, such efforts are often driven by external pressures or specific tasks, resulting in mechanical knowledge accumulation. In contrast, deep learning is driven by internal motivation and genuine interest. Deep learners actively reflect on the origins of knowledge, anticipate its future development, explore how it may change under different conditions, and consider strategies for addressing such changes.

3. Strategies for Building a Deep Learning Framework Based on Online Courses

3.1. Emphasizing the Dynamic Generation of Deep Learning Course Resources

To facilitate deep learning in online courses and overcome the limitations of traditional instruction—primarily its focus on knowledge acquisition—it is crucial to emphasize the dynamic generation of foundational teaching resources and recognize the value of resources developed throughout the learning process. Online course resources encompass dynamically generated teaching objectives, instructional content, micro-lesson materials, assignments, assessments, and topic-based discussion series. Establishing clear learning objectives and content forms the foundation of SPOC (Small Private Online Course) platforms and serves as a guiding direction for both course development and learner engagement. These objectives and resources should be dynamic and adaptable. The instructional team

should adopt a learner-centered approach, generating resources based on students' proficiency levels, interests, and the course syllabus. In the context of deep learning, online course implementation should continuously adjust and update objectives and resources in response to evolving learner needs, variations in the learning process, and feedback on learning outcomes. This iterative process not only enriches course materials but also enhances knowledge comprehension and transfer, thereby supporting deep learning. Furthermore, online courses should prioritize interactive learning experiences, foster the creation of generative learning resources, and move beyond the traditional model where instructors are the sole resource providers. Learners should actively contribute to resource creation throughout the learning journey.

3.2. Highlighting Deep Learning Teaching Design Based on Construction and Transfer

To achieve the deep learning objective of cultivating higher-order thinking and complex problem-solving abilities, online courses should prioritize problem-based and project-based instructional design. Personalized deep learning represents a concentrated manifestation of the "student-centered" educational philosophy. It emphasizes stimulating students' intrinsic motivation through well-designed external interventions, thereby facilitating a state of deep cognitive engagement. In this context, learners are empowered to adopt flexible and advanced learning strategies, ultimately achieving a profound understanding of the core concepts and underlying principles of the subject matter [8]. This approach fosters the development of critical thinking and analytical skills. Leveraging dynamically generated digital course resources, the instructional team should conduct in-depth analyses of course content, evaluate available teaching materials and learner profiles through the online platform, integrate key instructional challenges and focal points, and design complex, real-world problem scenarios. Instructional activities, tasks, discussion prompts, and video micro-lessons should all be designed around problem-based scenarios to stimulate student engagement and cognitive development. These scenarios should be engaging, thought-provoking, and capable of activating prior knowledge. Learners should collaborate in groups to explore and tackle problems, facilitating knowledge construction in authentic contexts. Ultimately, they should produce project reports through simulations, task presentations, or similar methods, enabling knowledge transfer and creative application in comparable situations. This approach enhances the ability to address complex, real-world challenges. Course designers and facilitators must carefully plan and implement corresponding learning activities to ensure effective group collaboration and knowledge construction throughout the instructional design and delivery process.

3.3. Strengthening the Collaborative Construction of Virtual Communities for Deep Learning

The realization of deep learning in online courses necessitates effective collaborative inquiry learning and critical reflective dialogue, which are essential for cultivating critical thinking and higher-order cognitive skills. The Community of Inquiry (CoI) model, composed of three core elements—teaching presence, social presence, and cognitive presence (Garrison et al., 2001)—suggests that the development of virtual inquiry communities in online learning environments should emphasize the coordinated advancement of these three components.

Learning presence contributes to learners' self-efficacy and the development of self-regulated learning strategies, serving as a key regulatory mechanism in blended learning contexts. It facilitates the pacing and comprehension of instructional content within teaching presence and enhances peer interaction and social connectivity within social presence.

Within virtual inquiry learning communities, the primary function of teaching presence is to design and deliver course content, organize and facilitate learning activities, and effectively utilize digital platforms to coordinate, monitor, and manage purposeful critical discussions and collaborative reflective practices. Through direct instructional guidance, identification of misconceptions and learner needs, and timely feedback, teaching presence ensures the attainment of intended learning outcomes and supports learners in becoming reflective inquirers equipped with metacognitive awareness and strategies throughout the learning process [9].

Social presence primarily reflects the social and emotional competencies demonstrated by learners in virtual environments and significantly influences the overall interactional climate and cohesion of the virtual community. To foster a supportive and intellectually engaging learning atmosphere, social presence should be cultivated through purposeful instructional design that promotes meaningful dialogue, strengthens peer trust, supports collaborative knowledge construction, and nurtures a harmonious, open, and intellectually rigorous virtual inquiry community.

3.4. Deepening the Analysis of Teaching Evaluation Behaviors in Deep Learning

The core components of teaching evaluation in the context of deep learning encompass both teacher evaluation and student assessment. Teacher evaluation involves a comprehensive appraisal of teaching methodologies, instructional processes, and educational outcomes. In addition to traditional student feedback, peer evaluations, and indicators related to pedagogical innovation and reform, quantifiable behavioral metrics—such as the volume of online course materials up-

loaded, engagement in online and offline instructional activities, and the management of virtual learning environments (including the assignment and facilitation of unit-based discussion tasks, the timeliness and frequency of student inquiries, and the design, monitoring, and feedback of offline collaborative learning tasks)—are integral to teacher assessment frameworks. Furthermore, the diversity and innovativeness of instructional content and activities, both online and offline, as well as the realization of experiential and holistic learning experiences aligned with the goals of deep learning, should be incorporated into evaluation criteria.

Student evaluation, on the other hand, entails a comprehensive review of various learning behaviors, including participation levels, task completion rates, and learning outcomes. Beyond conventional final examinations, flipped classroom models in online education emphasize a series of deep learning-based activities aimed at internalization and experiential understanding. The autonomy and engagement demonstrated in both online and face-to-face learning settings, the completeness and collaborative nature of task execution, and the critical and reflective dimensions of the learning process all constitute key criteria for ongoing assessment.

With the advancement of artificial intelligence technologies, intelligent assessment systems are gaining increasing prominence. Issues concerning the scientific and effective evaluation of interaction depth have drawn growing scholarly attention. Some studies have proposed corresponding evaluation dimensions and indicators based on the concept of presence, integrating multiple elements within discussion processes. These frameworks align evaluation with the objectives of deep learning, promoting learning through assessment and fostering higher-order thinking through discussion. At various levels—individual contributions, individual learners, group dynamics, and community interactions—these systems enable relative and real-time automated evaluations across multiple dimensions, offering a scientifically robust and reliable approach to assessing online discussion activities [10]. By leveraging big data technology, it is possible to construct a comprehensive profile of students' learning conditions, dynamically capturing their diverse learning characteristics and developmental trajectories. This facilitates a detailed representation and in-depth analysis of the deep learning process, thereby offering a more thorough and nuanced understanding of students' engagement in deep learning [11].

4. Conclusion

In the era of information-based learning, as online courses continue to proliferate and course platforms and learning communities expand, the effectiveness of online learning has become a central concern. Deep learning plays a pivotal role in achieving meaningful and effective online education. This paper examines the characteristics and theoretical founda-

tions of deep learning within the educational domain and integrates these insights with the unique features of online courses. It identifies four key factors in constructing a deep learning framework for online education: the dynamic generation of deep learning resources, the emphasis on construction and transfer in instructional design, the collaborative development of virtual learning communities, and the refinement of behavioral analysis in evaluation. Based on these dimensions, the paper proposes concrete strategies for implementing deep learning in online course settings.

Abbreviations

NRC	National Research Council
SPOC	Small Private Online Course

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Conflicts of Interest

The author declares no conflicts of interest.

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