Deep Learning Oriented "Large Unit" Teaching Study: Model Construction and Case Studies

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Abstract. The educational changes in the 21st century require the cultivation of learners with lifelong learning ability, innovation spirit and problem-solving ability, while the above-mentioned ability and thinking development require deep learning as a means. The article analyzes the inner logic connection between deep learning and large-unit teaching design, and from the connotation of large-unit teaching design, it designs a large-unit teaching model oriented to deep learning, which provides a practical path for the implementation of core literacy; at the same time, it takes the U.S. "Mars Education Project" as an example for in-depth analysis, and explores the practical ways of integrating deep learning and specific. It also provides reference for teachers to carry out large-unit teaching.

Keywords: Large unit teaching · Deep learning · Core literacy

1 Introduction

Deep learning, as one of the research hotspots during the 13th Five-Year Plan, is the focus of the current education reform and a topic closely watched by front-line s. Deep learning requires us to explore new forms of classroom content organization, which coincides with the requirement of cultivating subject core literacy in the new curriculum. And the realization of core literacy goals requires teachers to shift from focusing on single knowledge points to large unit design. From the perspective of the whole unit, large-unit teaching breaks through the traditional classroom lesson design: it enables students' core literacy development to be put into practice and deep learning to be realized. Accordingly, this paper proposes a large-unit teaching model for deep learning by exploring the inner connection between large-unit teaching and deep learning, conducting teaching practice and effect analysis, and providing effective strategies and suggestions for teaching practice.

2 A Theoretical Investigation of the Relationship Between Deep Learning and Large Unit Teaching

2.1 Large Unit Teaching

A large unit is a structured whole formed by the organization of literacy objectives, lessons, contexts, tasks according to certain norms, and is a second-degree development, design, and integration of the content of the teaching unit, resulting in a basic unit of

X. Yuan et al. (Eds.): ICEKIM 2023, AHCS 13, pp. 913–920, 2023.
https://doi.org/10.2991/978-94-6463-172-2_96

teaching with clear thematic goals and tasks [1]. When teachers design a large unit of instruction, the unifying role is no longer played by isolated knowledge points and chapters, a knowledge point or a text, but by "big" ideas, projects, and problems. It is a new type of instructional design that has evolved from single chapter teaching to unit teaching and then to subject matter teaching.

Deep learning refers to the process of deep processing and application of knowledge by students through higher-order thinking skills such as questioning, critiquing, and thinking [2], and the 2017 Horizon Report (Higher Education Edition) published by the New Media Consortium of the United States argues that deep learning will be an important factor influencing decision making in higher education institutions in the next five years and beyond [3]. The characteristics of large units in terms of systematic instructional design, emphasis on authentic contexts, and transfer of higher-order thinking and abilities are consistent with the inherent requirements of deep learning, but the current research mainly focuses on the conceptual analysis, value implication, and instructional design methods of large units, while less attention has been paid to the relevance of large units to deep learning and the specific countermeasures of large units instructional design. Therefore, it is necessary to explore the inner connection between large units and deep learning.

2.2 The Inner Connection Between Large Unit Teaching and Deep Learning

Large-unit teaching emphasizes real and complex contexts as the environment in which learning occurs and the vehicle for problem solving. Situated cognitive theory, as one of the theoretical foundations of deep learning, emphasizes the contextuality, connectedness, and transferability of knowledge, which has unity with the inherent requirements of large-unit teaching. The instructional design, constructive strategies and learning styles of deep learning all reflect the integration perspective. Yunguo Cui proposed that integration should be the logic that deep teaching adheres to [3]. Large-unit teaching emphasizes structuring the classroom from the perspective of integration, reflecting on the process with a metacognitive viewpoint and testing the effectiveness with a generative viewpoint, which fully reflects the theoretical basis of deep learning.

It is difficult for learners to integrate fragmented knowledge when faced with isolated and extensive information. Deep learning requires teachers to flexibly integrate teaching materials, connect isolated knowledge elements, make the content "flexible" and "framed", and guide students to store knowledge in memory in an integrated and contextualized way [4]. Large units of instruction are capable of organizing related information in a rational and effective way, reducing the cognitive load of the learners in the process of schema organization, which is exactly the process that can be accomplished. The problem of over-emphasis on the form of the activity and the low quality of the activity can easily occur in the current curriculum teaching activities. It also provides a good practice path for the implementation of deep learning.

Finally, large-unit instruction requires the integration of knowledge from different academic levels and disciplines around a specific topic, and therefore requires large-scale tasks, themes, and projects as the vehicle for teaching content. Project-based teaching aims at completing authentic tasks and emphasizes more authentic and integrated project themes to guide students' learning and form certain works [5], which provides a good

curriculum format for large-unit teaching by driving students to become active inquirers of knowledge through challenging tasks. Students need to integrate multiple resources to think deeply and practice inquiry in the process of completing project works, which is also the process of deep learning [6]. The goal of large-unit instruction is to achieve deeper learning for students. The goal of large-unit instruction is to achieve deeper learning for students. And the instructional design under the concept of deep learning usually takes high-level cognitive tasks as the carrier and develops higher-order thinking as the core feature, so large-unit teaching and deep learning have an internal logical consistency.

Connection and migration are important features of deep learning, and large-unit teaching requires students to transfer, connect, and process knowledge in depth, reflecting more depth of thinking and innovation in the process. And the ultimate goal of deep learning is to acquire higher-order thinking and problem-solving skills through meaningful learning such as information integration, critical understanding, and migration and application, so the logical unity of the two in terms of student development goals is mutually integrated.

3 Construction of a Deep Learning Oriented Large Unit Teaching Model

The three main ideas of large unit instructional design in foreign countries are "reverse instructional design", "constructivist instructional design" and "triadic instructional and assessment design".

This study is oriented to promoting students' critical understanding and cultivating higher-order thinking, highlighting the holistic, phased and thematic characteristics of large-unit teaching, drawing on the main stages of reverse teaching design and making appropriate additions, and constructing a large-unit teaching model oriented to deep learning from three aspects [7]: teaching process, teacher and student activities, and teaching objectives, as shown in Fig. 1

Before engaging in formal instructional activities, teachers first need to form sound judgments about the prioritization of learning end goals from a holistic perspective and to appropriately control the competencies needed to complete tasks to avoid problems of loose instructional structures. Second, teachers need to explore and reflect on the process of the desired outcomes that can be achieved by the instructional activities. In this process, teachers need to integrate the content of the materials and refine the themes of the larger unit of instruction.

After this, the teacher needs to reflect on whether the evidence obtained so far is sufficient to make inferences about the level of skill mastery and understanding. After concluding the pre-course work, teachers need to think about how to create authentic contexts to facilitate deep learning. Next, teachers need to break down the large unit topic tasks by creating core questions based on authentic contexts and guide the lesson activities. After creating key questions, teachers need to design staged learning tasks that clarify and refine the learning content for each stage, linking each learning stage through questions and tasks. The design of staged tasks not only helps to provide logic and continuity to the teaching process, but also helps to provide students with a scaffold

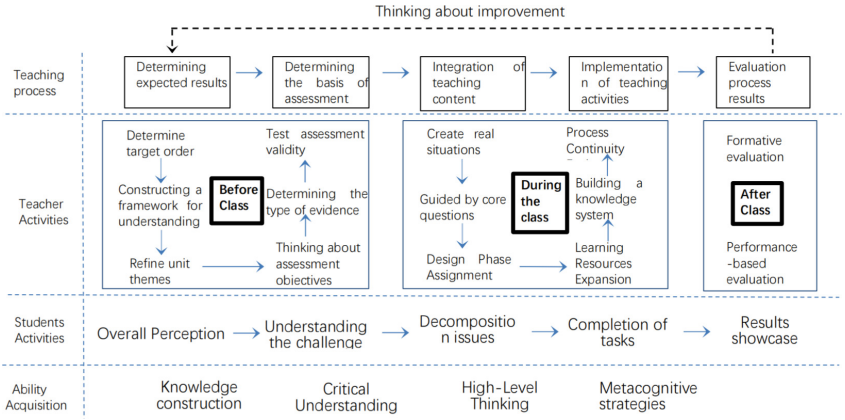

Fig. 1. "Big Unit" teaching model for deep learning

for decomposing the problems. In the evaluation process result stage teachers need to establish a scientific evaluation mechanism to assess students' performance in the activity process through formative evaluation and process synthesis to stimulate students' discussion and communication in order to improve the teaching process.

The large-unit model for deep learning provides a complete instructional design for the learning process, in which students need to use relevant resources for independent inquiry, cooperative learning, and the use of higher-order thinking and cognitive skills in order to complete specific tasks [6]. In addition, each stage of the large-unit instructional design needs to be based on authentic contexts, and only when students use specific skills or knowledge to complete tasks in authentic contexts can the acquired knowledge and thinking be better transferred to the real world, thus developing higher-order thinking and key competencies [8]. Finally, the model complements the student activities at each stage and improves the part of students' perception and comprehension behaviors before and after the class, reflecting the "double subject" feature of teachers and students in the subject matter.

4 Application and Effectiveness Analysis of Deep Learning Oriented Large Unit Teaching Model

In order to fully integrate the concept and application of deep learning, the study relied on 17 learners aged 9–12 in Kunming, Yunnan Province, who had more than one year of experience in programming for children. Based on the proposed teaching model and the ICMC International Robotics Competition project, the study further refined it into a teaching activity using reverse design thinking and designed a deep learning-oriented large-unit teaching activity "Moon Base Adventure". The effectiveness of the implementation of the teaching model was also quantified and analyzed.

Table 1. Large unit of teaching content of "Moon Base Adventure" project

Topics	Specific content
Building a bridge for mine traffic	Using the engineering principle of mechanical device to make the traffic bridge operate successfully
Rescue of radar detectors	Using LEGO Wedo teaching aids and its parts to assemble the work, program the repair task of making the detector rotate more than 3 times
Magic Electricity Engineering Vehicle	Build a model engineering vehicle and make it run to achieve successful opening of solar panels
Automatic navigation beacon change	Using the EV3 mainframe and its parts, assemble the piece, program it and complete the task of replacing the beacon
Smart Repair Generator	Built an EV3 robot with gripping, replacement, and installation functions and programmed it to repair the gear parts of the generator.

4.1 Teaching Content

Under the guidance of deep learning theory, the research is divided into five themes for the "Moon Base Adventure" project, and the teaching content is shown in Table 1.

4.2 Quantitative Analysis of Teaching Effectiveness

The degree of learners' mastery of the formation of subject concepts and the connections between concepts directly reflects the degree of organization of learners' cognitive structures. Concept maps are a common approach to evaluate students' in-depth learning in current teaching, so the study used large-unit concept maps to assess students' understanding and mastery of knowledge in large-unit instruction. Among the students' concept maps are shown in Tables 2 and 3.

From the achievement of concept mapping before and after the practice of large-unit teaching, it is clear that the large-unit teaching model and its practical application are helpful for learners' conceptual construction and cognitive thinking development of the unit.

The evaluation of deep learning ability is mainly based on two orientations: learning process and learning outcome, and has the characteristics of diversified, process-oriented

Table 2. Conceptual mapping before large unit teaching practice

Group	Number of concept map recoveries	10 points	5 points	3 points	Compliance rate
Group 1	8	2	3	3	62.5%
Group 2	7	1	3	3	57.1%

Table 3. Concept mapping after large unit teaching practice

Group	Number of concept map recoveries	10 points	5 points	3 points	Compliance rate
Group 1	9	3	4	3	77.8%
Group 2	8	2	3	3	62.6%

and performance-based evaluation. Therefore, the study developed an evaluation index system based on these two aspects, including five aspects: learning motivation, learning strategies, knowledge system, transfer ability, and cooperative communication. Before carrying out the large unit teaching, the 17 learners who participated in the teaching were divided into two groups for pre and post tests of basic knowledge, and the results of the pre and post tests were tested in SPSS with Shapiro-Wilk test to investigate whether the small sample data conformed to normal distribution, and the pre and post tests of the two groups are shown in Table 4.

The P-values of the pre and post-test sample data of the 2 groups of learners were > 0.05, which conformed to a normal distribution of small sample data. The pre- and post-test data were then imported into SPSS for t-tests, and the results of the analysis are shown in Table 5.

By analyzing the pre-test and post-test means as well as standard deviations and P-values of the five aspects of deep learning, we can see that the three aspects of students' learning motivation, knowledge system, and transfer ability have been improved, while

Table 4. Shapiro-Wilk test results

Indicators	**Pre-test**	
	w	***p***
Learning Motivation	0.90145	0.10501
Learning Strategies	0.91476	0.07811
Knowledge System	0.91862	0.06513
Migration capability	0.92101	0.13309
Cooperation and communication	0.92009	0.09213
Indicators	**Post-test**	
	w	***p***
Learning Motivation	0.92521	0.12932
Learning Strategies	0.94120	0.22390
Knowledge System	0.91156	0.07901
Migration capability	0.92801	0.10502
Cooperation and communication	0.92110	0.11098

Table 5. Results of t-test for sample data

Indicators	Pre-test X ± SD	Post-test X ± SD	**P**
Learning Motivation	20.40 ± 3.68	21.75 ± 3.10	0.0231
Learning Strategies	18.21 ± 2.06	18.79 ± 2.10	2.2041
Knowledge System	21.75 ± 3.46	22.01 ± 4.01	0.0147
Migration capability	23.32 ± 4.36	24.03 ± 3.05	0.0298
Cooperation and communication	31.45 ± 1.06	32.61 ± 3.16	0.0741

the two aspects of learning strategies and cooperative communication still need to be improved, and the reasons for this are analyzed as follows.

The learners are in the third and fourth grade primary school students, who are more interested in STEM interdisciplinary knowledge and have a certain knowledge base, so their internal drive to learn is relatively strong. However, since this is the first time that learners are exposed to large units of instruction, the specific implementation and teaching contents are more difficult for them, which makes them feel intimidated, so their performance in adjusting their learning strategies independently needs to be improved. Large-unit teaching focuses on the connection between the learning content and real life, so the transferability of knowledge is more emphasized, and learners have more obvious improvement in this aspect. However, learners are younger and more likely to seek help from the teacher to solve problems, and less likely to cooperate and communicate with other students.

5 Conclusion

The large-unit instruction is oriented to deep learning, realizes meaningful learning by designing key tasks and core problems, and develops students' transferable higher-order thinking and abilities, which is an effective way to realize deep learning and cultivate students' disciplinary core literacy. The large-unit instructional design model designed by the study is feasible, effective, and replicable in practical applications. The study expects to provide reference cases for deep learning combined with large-unit instructional objectives, content and assessment methods for instructional design.

In the process of exploring the practical path of deep learning, we need to clarify the specific representations of deep learning in different disciplines, in addition to the ability of critical thinking, creative consciousness and innovation, and problem solving as references, and on this basis to form a deep learning realization path with disciplinary characteristics. In the process of building and applying the large-unit teaching model, we need to think about how to integrate core literacy elements such as information awareness and computational thinking into the large-unit teaching design, and how to effectively combine students' group intelligence level and individual inquiry ability, in order to achieve better results for the integration of deep learning and large-unit teaching.

Acknowledgment. First of all, I would like to thank my supervisor, Ms. Yang, for her help in writing this dissertation and for providing me with valuable advice in my academic research. During the preparation of this thesis, she spent a lot of time reading each draft and provided me with inspiring advice. The completion of this dissertation would not have been possible without her patient teaching, insightful criticism, and professional guidance.

Yunnan Normal University Doctoral Initiation Project (2018ZB002).

References

1. Cui Yunguo. How to carry out the design of large units pointing to subject core literacy [J]. Beijing Education (General Education Edition),2019,No.845(02):11–15.
2. Kang, Shu-Min. A study on deep learning based on disciplinary literacy cultivation [J]. Educational Research, 2016,(7):113- 120
3. Becker S A , Cummins M , Davis A , et al. NMC Horizon Report: 2017 Higher Education Edition [J]. Journal of Open Learning, 2017.
4. Hu H, Li YX, Lang QE, et al. The occurrence process, design model and mechanism elucidation of deep learning [J]. China Distance Education (Comprehensive Edition), 2020(1): 54-61.
5. An Fuhai. A study of classroom teaching strategies to promote deep learning [J]. Curriculum. Textbook. Teaching method, 2014,34(11):57-62.DOI:https://doi.org/10.19877/j.cnki.kcjcjf.2014.11.011.
6. Dolmans Diana H J M et al. Deep and surface learning in problem-based learning: a review of the literature.[J]. Advances in health sciences education : theory and practice, 2016, 21(5) : 1087–1112.
7. [US] Grant Wiggins, Jay McTeague. Instructional design in pursuit of understanding [M]. Yan Hanbing,Song Xuelian,Lai Ping,Translated. Shanghai:East China Normal University Press,2017.
8. 9. Cui Yunguo. Academic core literacy calls for large unit teaching design[J]. Shanghai Educational Research,2019(04):1.