A Critical Analysis of the Advantages and Limitations of the Teaching Methods under the Constructivism Theory

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Abstract: In recent years, the application of constructivism theory in courses has grown remarkably. Given the diverse teaching conditions and the varying needs of students, teachers frequently struggle to select suitable teaching approaches. It is essential to determine how teachers can effectively apply these methods to transition to a student-centered learning environment, enabling students to genuinely master what they have learned. Thus, a comprehensive analysis of the advantages and limitations of these methods is essential for teachers to make informed decisions. This study combines literature review with case analysis to explore these aspects. The results show that firstly, the scaffolding instruction is flexible but demands much from teachers, which has limited impact on student motivation, and presents more flaws in online courses. Secondly, the anchored instruction boosts confidence and grades, yet it requires complex evaluation and specific scenarios. Finally, the random access instruction stimulates interest and independent thinking but does not lead to improved grades, lacks teacher-student interaction, and needs strict evaluation.

Keywords: Constructivism theory, Scaffolding instruction, Anchored instruction, Random access instruction, Case analysis

1.   Introduction

The traditional "cramming" teaching mode neglects students' central role, lacks teacher-student communication, and is monotonous [1]. It can not meet the need for cultivating all-round talents today. Therefore, innovative teaching methods are in demand. Constructivism, rooted in Piaget, stresses students' active exploration and meaning-constructing. It prioritizes student engagement and values the transformation of knowledge rather than adhering solely to a teacher-led model [2]. This challenges the examination-oriented and teacher-centered mainstream nowadays.

Heli Ainjärv's research findings indicate that the implementation of constructivism theory in curricula has significantly increased since 2018 [3]. Relevant studies have already statistically analyzed the application of constructivism teaching methods in different countries and across various subject areas [4]. There are even studies on its application in special teaching conditions, such as the use of scaffolding in online courses [5]. However, many of these studies lack a systematic and critical understanding of these methods, leading to mismatches with existing teaching conditions and resulting in ineffective outcomes or numerous challenges.

This paper employs literature review and case analysis to explore the advantages and limitations of various teaching methods under the constructivism theory, and puts forward requirements and

suggestions, aiming to assist educators in selecting appropriate teaching methods and provide references for the practical application of constructivism teaching methods in the future.

2. Scaffolding instruction

2.1. Theory foundation

Scaffolding instruction is a process in which students receive guidance and assistance from those with more knowledge (usually teachers in this context) during social activities, and thus gradually become capable of independently completing learning tasks [6]. Dawn holds that scaffolding instruction is a systematic sequencing of content, materials, tasks, and instructional prompts, which is designed to optimize independent learning [7].

2.2. Case study

This study focused on five types of scaffolding, conceptual, metacognitive, procedural, strategic, and motivation, as their framework to figure out the teachers' conceptualization of scaffolding and evaluate the implementation of it in an online environment. The types of data resources included pre-interview surveys, semi-structured interviews, and online course observations [5]. Four teachers from the School of Education of R1 public universities implemented scaffolding instruction in online courses respectively:

Teacher Sam respectively used hard scaffolding and soft scaffolding according to students' needs, gradually minimizing the scaffolding as students' understanding deepened. He set up a discussion section and provided peer assistance in the assignments. However, Sam found it was difficult to build a harmonious relationship with individual students in the online environment, which restricted the provision of appropriate scaffolding.

Teacher Sarah used students' feedback as the main basis for scaffolding. She communicated with every student and always offered help. Her course covered five types of scaffolding teaching strategies. She also regarded building students' sense of belonging as one of the scaffolding teaching strategies. Sarah believed that teachers should actively participate in online teaching and evaluated the effectiveness of her teaching from students' positive feedback. However, she faced difficulties in accurately assessing students' levels of understanding in the online environment. Since effective scaffolding requires teachers to tailor their guidance to students' comprehension levels, any misjudgment could weaken the teaching outcomes. Also, there were challenges regarding the availability of teaching tools, such as the discontinuation of Padlet.

Teacher Elaina led students in discussions and established a weekly lesson reflection area (using platforms like Wiki or Padlet) [5]. She also adopted motivational scaffolding by sending encouraging emails to students. Elaina took students' progress as a sign of the success of scaffolding. But motivating students did not always produce significant results, so more methods needed to be explored.

Teacher Cora's course also included five types of scaffolding. She focused on students' social and emotional needs and adopted differentiated strategies for different individuals. She would reflect on the teaching after class and plan for improvements. However, Cora struggled to find the best way to communicate with students online and to personalize the Blackboard online platform.

2.3. Discussion

In terms of advantages, the scaffolding instruction can meet diverse needs, supporting students' academic learning as well as social and emotional needs, cultivating students' abilities of independent learning and cooperation, and even enhancing their sense of belonging. Besides, It is flexible and

adaptable. Teachers can use different types of scaffolding according to the characteristics of tasks and students. When it comes to the limitations, however, it has high requirements for teachers and resources. Teachers need to keep track of students' understanding levels, provide additional motivation, and plan for improvements after teaching. Plus, teachers also need to create a sense of belonging, which is unique to the online environment. Moreover, scaffolding may not significantly boost students' learning motivation, and it may be necessary to combine it with other teaching methods. This instruction has additional limitations in online courses. For starters, it is difficult to establish a harmonious relationship with individual students, which restricts the provision of suitable scaffolding. In addition, there is uncertainty in judging students' understanding levels, which may lead to inappropriate scaffolding. Unpredictable problems of teaching tools or personalized issues may also interfere with the implementation of scaffolding instruction.

3. Anchored instruction

3.1. Theory foundation

The steps of anchored instruction include creating a scenario, defining a question, and solving the problem. Teachers start by creating a scenario that connects to real-life situations related to the teaching theme, thereby sparking students' enthusiasm for exploring new knowledge. Defining a question is a fundamental step, as the entire teaching process revolves around the defined question. During the problem-solving stage, teachers should provide timely and appropriate clues while incorporating both independent and group learning approaches [8]. In anchored instruction, teachers should serve as both an information provider and a learner simultaneously. Teachers sometimes have to deviate from the pre-scheduled lesson plans and teach flexibly. Moreover, they need to truly experience the courses from the learners' perspective to understand when students need guidance during their knowledge-construction process [9].

3.2. Case study

This study took 130 undergraduate engineering students from a certain university as the research objects to explore the impacts and correlations of anchored instruction and traditional one.

This research focused on the innovative course Computation and Programming for Materials Scientists and Engineers (CPMSE), adopting the inverted classroom design method and following the anchored instruction [10]. It emphasized the reflection of computational thinking in specific and personal-related situations. For example, by having students watch online lectures, collaborate to solve problems, and complete design projects, the course combined theory with practice, enabling students to improve their computational abilities [10].

Computational learning modules were also integrated into the six core courses of this major. Anchored instruction was incorporated into the teaching. Through real learning experiences, students could use computational tools to solve practical problems.

Control assessments and value assessments were respectively carried out at the beginning and the end of the semester. Questionnaires were used to collect students' self-cognition data, and multiple-choice questions were used to measure learning outcomes.

3.3. Results

From the influence on students' self-cognition, the research shows that for students exposed to anchored instruction, their control assessment scores have improved. There is a significant increase in the value assessment especially for students with no programming experience before. Moreover, regardless of students' experience, on average, introducing real computational learning practice can

effectively help students understand computation in the scenario of the subject [10]. However, the computational modules have a relatively small impact on students' value assessment.

As for the influence on students' learning, the configured method is helpful for the learning of students in different programming experience groups, and the academic performance of students with no foundation has been greatly improved [10].

3.4. Discussion

Anchored instruction offers several advantages, including a positive impact on students' self-perception of their abilities and their assessment of the value of the knowledge they acquire. This approach enhances students' learning confidence and motivation. Additionally, it has been shown to promote academic performance and is effective for students at all levels of prior experience, with particularly significant benefits for those with no foundational knowledge.

For subjects that involve complex theories and provide limited opportunities for real scenarios, anchored instruction can make up for the deficiencies of traditional education. Nonetheless, it is more suitable for teaching conditions where an assessment system with high validity and reliability can be established to accurately evaluate the teaching effect. Moreover, it highly depends on specific scenarios. If the set scenarios cannot comprehensively cover various situations and depths of the subject in practical applications, it may lead to students' insufficient understanding of the value of the subject. Therefore, it has higher requirements for teaching resources, technology, and teachers' guiding abilities.

4. Random access instruction

4.1. Theory foundation

Random access instruction means that teachers deliberately create different learning situations, and the students construct the knowledge from diverse perspectives so as to acquire a multiple-dimentional understanding. [11].

Similarly, flexible learning adapts to individual learners' needs by providing diverse learning paths [12]. Random access instruction is based on the cognitive flexibility theory proposed by Spiro et al., which emphasizes the importance of active student participation and the maintenance of cognitive flexibility for effective two-way knowledge construction [13]. He proposed the Random Access Instruction, whose purpose is flexible learning [14]. Therefore, this paper regards "Flexible Learning" as a form of the random access instruction, and discusses it in the subsequent analysis.

4.2. Case study

This study took the students participating in the traditional undergraduate Life Sciences courses at Napier University as the research objects, and used qualitative and quantitative methods to statistically compare the text-based flexible learning teaching method and the traditional teaching method.

The study replaced 30% to 50% of the traditional teaching lectures with the text-based flexible learning teaching method. This approach allowed students to freely choose their own time and place, use interactive materials for learning, conduct self-assessment questions, complete interactive tasks or assignments, and actively discover problems and think deeply [15].

In the part of the exam where students could freely choose their examination questions, they were allowed to choose questions based on flexible learning teaching method or traditional teaching. The study organized an exam that included both the content taught through flexible learning and traditional teaching, and compared the scores of the two types of exam questions. Then they

organized another exam that contained at least 50% of the content taught through flexible learning and another with at least 50% content through traditional teaching. The median proportion of students meeting the standard (40%) was then compared for both exams. At the end of the project, the students provided feedbacks through formal (questionnaires) and informal ones. Finally, the teaching method was evaluated through the quality assurance system.

4.3. Results

The scores achieved by students on exam questions based on the content taught through flexible learning were comparable to those for questions based on traditional teaching. In the exam that contains at least half of the topics through flexible learning, the number of students who initially met the standard (40%) was significantly larger than that in the exam that contains at least half of the topics taught through traditional teaching methods. Besides, students tended to choose the questions based on the content taught through flexible learning in the exam and showed great enthusiasm and demanded more flexible learning opportunities. In conclusion, this flexible learning project met various quality assurance standards within the university.

4.4. Discussion

The flexible learning method offers several advantages, including the ability to stimulate students' interest in learning and cultivate their independent thinking skills. Its high degree of learning freedom and strong flexibility allows for a teaching form in accordance with individual aptitudes. However, it has no significant effect on improving academic performance, or it may take a relatively long time to see the effect. Furthermore, it has high requirements for learners' self-discipline, and there is a lack of face-to-face and timely communication between teachers and students. One thing needs to be noted is that students exposed to flexible learning for the first time need to be given additional support. And it requires a more rigorous formative assessment.

5. Enlightenment

First of all, in the educational application of constructivism theory, there are challenges of category confusion. If educators lack an understanding of the definitions, conditions of application, as well as the advantages and limitations of these teaching methods, they may end up with results that require twice the effort but yield only half the effectiveness. Therefore, students and teachers should be guided to conduct critical thinking and reflection. Also, teachers need to consider multiple factors when choosing or combining teaching methods, as there is no "best" approach [16]. Furthermore, relevant policies should be formulated to provide sufficient training opportunities to help teachers be familiar with and master various teaching theories and methods. Last but not least, policies should also promote the fair distribution of teaching staff and resources, and carry out mutual-assistance activities to facilitate the common growth of teachers' professional capabilities. For instance, there can be more educational research campaigns and teacher exchange program between schools.

6. Conclusion

In conclusion, this paper sorts out the advantages and limitations of three teaching methods under the constructivism theory, and drawn the following conclusions. Firstly, even though scaffolding teaching has high requirements for teaching staff and conditions, and its effect on improving students' learning enthusiasm is limited, it can meet diverse needs, and is flexible and highly adaptable. Secondly, anchored instruction has high requirements for evaluation and is dependent on specific scenarios, but it can well enhance students' confidence and their academic performance. Thirdly, as

for random access instruction, while it does not show a short-term impact on grades and lacks face-to-face communication, it successfully stimulates student interest and fosters independent thinking.

However, due to the small number and types of cases, the conclusions may not be universal. Future researches can expand the scope of literature and cases to ensure the authenticity and universality of the conclusions. In addition, this paper also lacks a visualized as well as systematic data base, which may lead to inconvenience to the comparison of the results.

With regard to the prediction of the research directions, the author anticipates more studies on how to design examination questions that align with the student-centered teaching approach within the constraints of today's exam-oriented education system.

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