Discussion on Teaching Strategy of Algorithm in Primary School

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Abstract. This paper discusses how to carry out the exploration and practice of algorithm teaching in information technology courses. The paper first emphasizes the importance of algorithm in computational thinking and artificial intelligence, and then introduces an innovative teaching mode, namely the "double-guide and double-direction" five-link teaching mode in detail, and illustrates the specific application of the mode by enumerating the teaching cases of algorithm and recursive algorithm. Then, the paper puts forward the concept of optimizing the learning effect of the theme of "algorithm around", and shows how to improve students' learning interest and the practicability of algorithms through greedy algorithm and examples in life. In addition, the paper also emphasizes the importance of teaching evaluation, and puts forward the method of promoting the integration of teaching evaluation.

Keywords: algorithm teaching; information technology course; double-direction and five-link teaching mode; teaching evaluation; core literacy education.

1. Introduction

Algorithms are fundamental to computational thinking and play a crucial role in the widespread application of artificial intelligence, along with data and computing power [1]. In our daily lives, we encounter algorithms everywhere, from solving equations to discovering patterns. In the field of information technology, students become familiar with commonly used algorithmic styles and methods while studying algorithm modules. They learn how to describe algorithms for solving simple problems using natural language, flowcharts, and other techniques. Moreover, they engage in discussions analyzing the correctness and efficiency of these algorithms. This paper aims to explore teaching methodologies by focusing on various algorithm modules such as enumeration algorithms, recursive algorithms, iterative algorithms, and greedy algorithms. The objective is to enhance students' understanding of basic concepts and applications of algorithms while fostering their learning abilities and innovative spirit within the digital environment.

2. Deepening the reform of information teaching and creating an efficient algorithm classroom

2.1 Classroom innovation, creating a "double-directional" five-link teaching mode

In the information technology classroom, the teaching case of enumeration algorithm and recursive algorithm is introduced to let students understand and master the algorithm idea in practice. Grasp the main battlefield of "classroom", with engineering literacy and information technology literacy as the core, "cooperation-inquiry" teaching reform as the breakthrough, "teacher-student interaction and hands-on brain" through the "observation-design-practice-sharing-extension" learning process, and optimize the "double-action five-step cooperative" learning strategy. Take enumeration algorithm as an example, enumeration algorithm is a basic algorithm idea. It divides the problem to be verified into a limited number of possible solutions, and tests each situation separately, and finally gets the best solution. When solving the problem, enumeration algorithm needs to list all possible situations one by one and screen them. In the observation link, the attention of students is attracted by playing blackjack to increase their interest and curiosity about the content they are about to learn. The rules of the game
are assumed to have three numbers 2, 3, and 5 cards, representing points 2, 3, and 5, respectively, and each kind of cards has any number of cards. Add the numbers on all the cards to make up 21, what is the number of cards? In the design link, through hands-on practice, students can understand the basic concepts and applications of enumeration algorithm, recognize the possible limitations of enumeration algorithm in dealing with complex problems, and understand how to optimize enumeration algorithm by adding constraints. Such design helps cultivate students' algorithmic thinking and problem-solving ability. For each card, add some constraints, for example: the number 5 is 4 cards at most, the number 3 is 7 cards at most, and the number 2 is 10 cards at most. Guide students to draw flow charts, and turn natural language into flow chart description. In the practice link, provide a graphical programming scaffold, and guide students to realize the blackjack game through programming. In the sharing link, students are invited to share, evaluate and learn from each other. In the extension link, students can be stimulated to think about what problems are suitable for enumeration algorithm in life and other subjects. Students can think of chickens and rabbits in the same cage, Han Xin's troops and buying a hundred chickens with a hundred dollars.

2.2 Optimize the learning effect of the theme of "algorithms around us"

The concept of refreshing and optimizing the learning effect of "algorithm around" is combined with students' real-life experiences to design a step-by-step algorithm unit that enables students to comprehend common algorithms. For instance, in classroom lesson arrangements and scenarios involving backpack problems, algorithmic thinking is integrated to create a thematic course on greedy algorithms, enhancing students' interest in learning and the practicality of algorithms. To promote the implementation of new curriculum standards in classroom teaching, research and practice exploration are conducted focusing on "project-based learning" and "large-unit teaching", thereby improving teaching skills through a combination of research, study, and practical selection. This approach aims to generate high-quality cases that embody scientific forward-looking concepts and diverse learning patterns within the classroom while deeply integrating them with real-world applications. Taking greedy algorithms as an example, interesting scenarios from daily life are explored to facilitate students' understanding of algorithmic ideas and encourage their application in real-life situations. For instance, during an observation exercise where six people form a group led by one person who possesses six different candies of varying sizes; these candies need to be distributed among group members using only one bag at a time. The best distribution strategy involves selecting the largest candy each time it is available and giving it to one of the smaller partners until all candies have been distributed. Although this may result in some friends receiving more candy than others, the goal is for each choice made by individuals to be their best effort towards achieving an optimal outcome. Subsequently, students will be encouraged to comprehend the concept of greedy algorithms through practical algorithm design in diverse scenarios. Ultimately, students will be prompted to contemplate the real-life applications of greedy algorithms, akin to commonplace decisions we frequently encounter. For instance, when encountering a street vendor selling sugar-coated haws, instead of meticulously comparing flavors, we may opt for our preferred flavor directly. This approach offers the advantage of expeditious decision-making; however, it also entails the drawback that we may not always select the optimal sugar-coated haw flavor.

3. Deepen core literacy education and implement innovative approaches to algorithm teaching.

3.1 Pay attention to interdisciplinary integration.

Under the guidance of new programs and curriculum standards, in line with national educational reforms, enhance the school curriculum system by focusing on interdisciplinary integration and fostering students' comprehensive abilities. Strengthen curriculum development, update content, and consider students' interests and developmental needs. For example, using a game strategy as an
analogy combined with Chinese history and culture: during an observation activity, present a story where two individuals (A and B) encounter a tiger in the forest. A quickly discards items while running away while B is confused and asks if they should run over the tiger. A responds by saying they don't need to run over the tiger but just need to run faster than B! Then ask students what they would do if they were B. Presuming that B cleverly climbs up a tree since tigers cannot climb trees, thus chasing A away... This activity aims to guide students in understanding the importance of strategy within games. Introduce game strategies into thematic learning games during design activities; for instance, use Tian Ji horse racing as an example to explain algorithmic concepts through flowchart design. Finally, enable students to apply graphical programming techniques to realize game strategies within Tian Ji horse racing. During extension activities, encourage students to reflect on how rock-paper-scissors—a commonly played game—actually embodies principles of game strategy.

3.2 Focus on real life

Highlight the integration of information technology and education, enhance digital applications in teaching, and innovate teaching methodologies with a focus on real-life scenarios. For instance, consider employing a simple and relatable story to introduce the concept of recursive algorithms: Once upon a time, there was a mountain with a temple where an old monk narrated stories to young monks. What did he tell them? "Once upon a time, there was a mountain..." This approach aims to foster students' interest in recursive algorithms within a relaxed and enjoyable atmosphere.

By analyzing key scenarios presented in problem-solving exercises, students can comprehend fundamental concepts and applications of recursive algorithms while developing their logical thinking skills and programming abilities. Through exploring examples like the Fibonacci sequence calculation method, students will grasp both its mathematical aspects as well as the underlying principles of recursive algorithms.

Lastly, by engaging students in activities such as jigsaw puzzles that illustrate divide-and-conquer algorithms, they are encouraged to reflect on differences between divide-and-conquer approaches versus recursive ones. Furthermore, these activities prompt students to think creatively using everyday life examples; for instance: imagine having an oversized fruit plate filled with various fruits that is too heavy for one person to move alone. To address this challenge effectively you devise a strategy - dividing this large plate into four smaller plates each containing some fruit - making it easier to transport individually until all fruits are removed from the original plate. This process resembles both divide-and-conquer algorithmic steps as well as recursion techniques.

4. Establishing an innovative evaluation system in primary school information technology classrooms

4.1 Promote the implementation of 'teaching-evaluation integration

Emphasizing the holistic process of teaching implementation, we aim to achieve a high level of consistency and coordination between research and development design, classroom practice, and learning evaluation. Particularly during the evaluation stage, we encourage bold innovation attempts by adopting a pluralistic homework design model based on the principle of 'teaching-evaluation consistency.' We strive to build a student quality development evaluation system that encompasses a school-based implementation concept and structural framework for student evaluation while developing practical student evaluation tools. By focusing on concise information technology core literacy and designing evaluative metrics, we aim to break away from solely relying on scores and instead conduct online comprehensive quality evaluations to address academic assessment challenges in information technology courses.
4.2 Core literacy-oriented: Studying the new curriculum standard and formulating an appropriate evaluation system

The curriculum standard emphasizes supporting students in self-planning, self-management, and self-evaluation within digital learning environments; it also advocates for combining process evaluations with terminal evaluations as well as integrating self-evaluations with other forms of assessments to enhance students' independent learning abilities [1]. Based on this curriculum standard, our final objective is to establish an online multiple evaluation platform where teachers can upload students' academic performance in real-time for comprehensive assessments accessible by both students and parents.

Table 1 shows the classroom evaluation of the flashing lights developed based on the curriculum standards.

<table>
<thead>
<tr>
<th>Subject</th>
<th>Evaluation Item</th>
<th>Specific Content</th>
<th>Star Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>Student Self-evaluation</td>
<td>Attitude towards learning</td>
<td>Students are able to think critically and maintain a genuine interest in the topics being taught.</td>
<td>☆☆☆☆☆</td>
</tr>
<tr>
<td></td>
<td>Classroom participation</td>
<td>Students participate in the whole process of learning.</td>
<td>☆☆☆☆☆</td>
</tr>
<tr>
<td>Peer evaluation of students</td>
<td>Working in a group</td>
<td>Proficient in actively engaging in design and practice discussions and collaborations with peers.</td>
<td>☆☆☆☆☆</td>
</tr>
<tr>
<td></td>
<td>The impact of the study</td>
<td>The work has achieved the regulation of LED lighting.</td>
<td>☆☆☆☆☆</td>
</tr>
<tr>
<td>Evaluation of Teachers</td>
<td>Information Awareness</td>
<td>You can find common process and control systems in your daily life.</td>
<td>☆☆☆☆☆</td>
</tr>
<tr>
<td></td>
<td>Computational Thinking</td>
<td>Be able to name the three links of input, calculation, and output in the system</td>
<td>☆☆☆☆☆</td>
</tr>
<tr>
<td></td>
<td>Digital Learning and Innovation</td>
<td>Students are able to use open-source hardware to design, create, functional, and beautiful-looking work and share it.</td>
<td>☆☆☆☆☆</td>
</tr>
<tr>
<td></td>
<td>Information Society Responsibility</td>
<td>Students' work is able to empathize with a specific group of users.</td>
<td>☆☆☆☆☆</td>
</tr>
</tbody>
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5. Summary

This paper investigates the pedagogy of algorithms in information technology courses, highlighting their significance in computational thinking and artificial intelligence. It introduces an innovative "double-guidance and double-direction" five-link teaching mode, presenting algorithmic and recursive algorithmic teaching cases as illustrations. Moreover, it demonstrates how to optimize learning outcomes through the theme of "algorithms around us", utilizing examples of greedy algorithms from daily life to enhance students' interest and practical application of algorithms. Additionally, it emphasizes the importance of effectively integrating evaluation into instruction. In terms of core literacy education, subject integration is emphasized alongside a focus on real-life applications; game strategy and recursive algorithmic examples are employed to cultivate students' comprehensive abilities and problem-solving skills through instruction. Lastly, this paper proposes establishing an innovative evaluation system for primary school information technology classrooms that prioritizes holistic student development by incorporating algorithmic cases relevant to everyday life into instruction while adopting innovative teaching approaches and evaluation systems.

References