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Analysis of Interdisciplinary Thematic Integrated Curriculum Focusing on Core Competencies

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Abstract: To address the complex societal demands of the globalized and information age, this paper adopts an interdisciplinary thematic teaching approach to study an integrated curriculum in higher vocational education centered around the theme of "mobile phone battery charging time." The selected themes are related to students' cognitive development, interest exploration, and real-life experiences, integrating knowledge from disciplines such as mathematics, physics, chemistry, and information technology, and designing student-centered teaching activities. The study shows that interdisciplinary thematic teaching not only enhances students' mathematical application skills and problem-solving abilities but also effectively cultivates their multidisciplinary competencies, improving the efficacy and engagement of education.

Keywords: Core Competencies; Interdisciplinary Themes; Integrated Curriculum

Introduction

With the advent of globalization and the information age, traditional educational models can no longer meet the increasingly complex societal demands. Interdisciplinary thematic teaching, as an emerging educational model, is gaining widespread application. This teaching model emphasizes the integration of different disciplines and knowledge methods, based on students' cognitive development, interest exploration, and real-life experiences, conducting teaching activities around specific research themes with the goal of cultivating students' core competencies. In mathematics education, interdisciplinary thematic teaching can effectively connect mathematics with other disciplines, enhance the linkage between different disciplinary competencies, and improve students' ability to apply mathematical knowledge and solve real-world problems. With the aid of interdisciplinary teaching activities, students can gain a deeper understanding of the application of mathematical knowledge in the real world, cultivate their ability to observe from multiple perspectives and think innovatively, and learn and innovate in practice, thereby strengthening the efficacy and engagement of education. Therefore, this study explores the specific application of an interdisciplinary thematic integrated curriculum, with mathematics as the main thread, in higher vocational education, using "mobile phone battery charging time" as an example. This paper aims to provide practical guidance and strategies for educators and curriculum developers in related fields.

1. Selection and Design of Interdisciplinary Thematic Teaching

1.1 Determining the Interdisciplinary Theme

Interdisciplinary thematic teaching is a comprehensive and practical activity based on students' cognition, interest experience, and real-life, aimed at cultivating students' core competencies. It revolves around a specific research theme, integrating and applying relevant knowledge and methods from various subjects. The selection of the interdisciplinary theme is crucial to the entire teaching design. It must align with students' life experiences and cognitive levels, and also reflect the comprehensive application of multiple disciplines.

In this paper, we choose the common real-life scenario of mobile phone battery charging time. Using the central question, "How long does it take to fully charge a mobile phone battery?" we investigate the "changes in battery charge levels over different charging periods." From a mathematical perspective, this involves the application of exponential and linear functions in real life; from a physics standpoint, it covers the principles of battery charging; from a chemistry angle, it discusses the chemical reactions within the battery; and from an information technology perspective, it includes understanding battery management systems and their optimization methods. This theme not only enhances students' ability to apply mathematical knowledge but also fosters their multidisciplinary competencies.

1.2 Determining the Learning Content

The teaching design includes content from higher vocational mathematics courses related to exponential and linear functions, as well as

relevant knowledge from physics, chemistry, and information technology courses. The specific learning content is detailed in the table.

2. Teaching Analysis

2.1 Analysis of Learner Characteristics

Students at the higher vocational education level possess a certain foundation in mathematics and physics, but they are relatively weak in practical application and interdisciplinary integration. While learning about exponential and linear functions, they have understood the definitions, graphs, and properties of these functions, and have acquired some basic mathematical modeling methods. However, they generally lack awareness of independent exploration and interdisciplinary application. In their physics and chemistry courses, students have already learned the basic working principles of batteries and the chemical reactions involved, but they have limited knowledge about battery management systems and their optimization methods.

2.2 Analysis of Teaching Objectives

The interdisciplinary teaching objectives at the higher vocational education level should focus on the standards of each subject, the textbooks, and the actual situation of the students. They should not only meet the requirements of the curriculum standards but also align with the students' cognitive levels and life experiences. Based on this, and guided by core competencies, the following teaching objectives are established:

1) Develop mathematical modeling skills by establishing a model of the relationship between battery charging time and battery level using known data.

2) Understand the reasons for changes in battery levels by combining the principles of battery charging and chemical reaction processes, fostering a scientific outlook.

3) Master the basic principles of battery management systems and learn about battery charging optimization methods.

4) Cultivate students' interdisciplinary competencies and their ability to solve practical problems.

3. Teaching Process

3.1 Discovering the Problems

The lesson begins with a presentation showing research data on the battery charging levels (percentage) of a certain brand of mobile phone over different time intervals.

Question: What trend does this data show?

Group Activity: Students will work in groups to plot the data on a scatter plot and discuss their findings.

Presentation of Work: Selected groups will present their finished scatter plots and report their observations.

Student Report

The independent variable for this dataset is time, and the dependent variable is battery level. The data shows a trend where the battery level rises quickly at first and then gradually levels off.

Design Intent: The purpose is to have students go through the process of handling data and plotting a scatter plot to develop their data analysis skills and understanding of the relationship between numbers and shapes.

3.2 Posing the Question

Question: Why does this trend occur?

Student Hypothesis: Initially, the battery level rises rapidly because the battery is low and the charging efficiency is high. As the battery level increases, the charging speed gradually slows down due to the optimization strategies of the battery management system.

Knowledge Expansion: During charging, the initial current is large, leading to a rapid increase in battery level. In the middle stage, the current gradually decreases, slowing down the charging speed. In the final stage, as the battery approaches full charge, the current further decreases, significantly slowing the charging speed until the battery reaches 100%.

3.3 Analyzing the Problem

Question: How can we describe the relationship between battery level and time using a mathematical model?

Group Activity: Students will observe the scatter plot, discuss, and choose an appropriate mathematical model. A piecewise function can be used: a linear function for the initial stage and an exponential function for the later stage.

Model Building: Based on the data, students will establish a mathematical model. The piecewise function is as follows:

- Initial Linear Model: \(y = k_1 \cdot x + b_1 \)
- Later Exponential Model: \(y = k_2 \cdot a^{(x-x_0)} + b_2 \)

Students will calculate the specific model parameters based on the given data.

3.4 Solving the Problem

Students: Substitute the data into the model to calculate the battery level at different time points. By using the model, they will derive a specific function describing the battery level's change over time and use this function to predict battery levels at various time intervals, ultimately determining the time needed to fully charge the phone.

3.5 Expanding the Problem

Additional Information: In real life, the charging time for different brands and models of phones varies due to factors like battery capacity, charger power, and charging environment.

Question: What methods can be used to extend battery life in daily life?

Discussion and Report: Students will discuss and come up with methods such as avoiding overcharging and deep discharging, using the original charger, and maintaining an appropriate charging environment temperature.

Design Intent: The discussion on methods to extend battery life aims to cultivate students' scientific literacy and practical life skills.

Homework: Each group will write a short paper summarizing their work, including the modeling process, understanding of the battery management system, and methods to extend battery life.

Design Intent: This homework assignment encourages students to summarize and reflect on what they have learned, enhancing their comprehensive application abilities.

4. Conclusion

In summary, the interdisciplinary thematic teaching on the "charging cycle of mobile phone batteries" integrates mathematical theory with content from physics, chemistry, and information technology. This teaching model demands higher professional skills from educators. In practical teaching, teachers need to carefully assess students' learning characteristics, focusing on their knowledge and skill levels across multiple disciplines, with particular attention to their mathematical foundation and relevant knowledge from other subjects. Therefore, mathematics teachers should deeply understand their own subject, be proficient in related disciplines, and design teaching themes and problem cues that effectively integrate interdisciplinary knowledge, ultimately enhancing students' core competencies.

References

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