Teaching Design and Practical Research of the *Food Nutrition and Health* Course under the BOPPPS Teaching Model

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Abstract Guided by the "Healthy China 2030" strategy, improving national nutrition and health literacy has become a core task in public health system development. The *National Nutrition Plan* (*2017 - 2030*) explicitly calls for "strengthening the training of nutrition talents" and "promoting nutrition science education". As a key vehicle for this mission, the *Food Nutrition and Health* course in higher education urgently needs to address bottlenecks in traditional teaching, such as low knowledge application and transfer rates, insufficient student engagement, and ineffective guidance on healthy behaviors. The BOPPPS teaching model, with its structured design (Bridge-in, Objective, Pre-assessment, Participatory Learning, Post-assessment, Summary), effectively promotes the internalization of nutritional knowledge and the transformation into healthy behaviors among students by emphasizing practice-oriented teaching activities. In this study, focusing on this course, an in-depth exploration of curriculum teaching design was conducted based on the BOPPPS instructional model, aiming to deeply integrate the strategic objectives of Healthy China into the curriculum, and promote the transformation of nutritional knowledge into healthy decision-making ability. This study provides new insights for food and nutrition education.

Key words BOPPPS instructional model; *Food Nutrition and Health*; Teaching design

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The rapid development of the economy and society has provided people with abundant material benefits, while also leading to changes in dietary structures and lifestyles. Unhealthy dietary patterns and related lifestyles are closely associated with the development of various chronic diseases. Clinically, these contribute to the occurrence of metabolism-related chronic conditions, including non-alcoholic fatty liver disease (NAFLD), dyslipidemia, obesity, and insulin resistance[1-2]. Nutrition-related diseases have become a core challenge threatening global public health. According to statistics, the incidence of NAFLD in China has continued to rise since 2015. Compared with other regions, China has the highest incidence of NAFLD worldwide (82.59 cases per 1 000 person-years)[3]. The National Nutrition Plan (*2017 - 2030*) clearly states that the current nutritional health status of the population faces coexisting issues of undernutrition and overnutrition, frequent occurrence of nutrition-related diseases, and a lack of widespread healthy lifestyles. The *Food Nutrition and Health* course in universities serves as a primary platform and key vehicle for nutrition science education. Its teaching effectiveness can facilitate the internalization of nutritional knowledge among students and promote the transformation of this knowledge into healthy behaviors. However, given the diverse backgrounds of students across different age groups and disciplines, a critical challenge lies in how educators can innovate and structure teaching methods to guide learners in navigating the complexities of nutritional theory and effectively transformation knowledge into tangible health behaviors. The BOPPPS teaching model, with its structured design (Bridge-in, Objective, Pre-assessment, Participatory Learning, Post-assessment, Summary) and demonstrated effectiveness, provides methodological support for curriculum reform[4-5].

In this study, based on the theoretical analysis and practical application of the BOPPPS teaching model, the disciplinary characteristics and teaching requirements of the *Food Nutrition and Health* course was closely integrated to design a targeted and highly operable teaching plan. On one hand, it aims to enhance the teaching quality of the *Food Nutrition and Health* course, effectively stimulate students' interest and initiative in learning, and cultivate their self-directed learning abilities and innovative thinking. On the other hand, it provides new insights and approaches for the teaching reform of similar nutrition-related courses.

Introduction to the BOPPPS Teaching Model

The BOPPPS teaching model, a core achievement of Canada's Instructional Skills Workshop (ISW) teacher training system, originated from systematic exploration into effective classroom teaching structures. It aims to address issues such as vague objectives and insufficient student engagement in traditional classrooms through a scientifically designed teaching process[6]. Rooted in constructivist theory, this model emphasizes a clear learning objective as the guide, and connects six interrelated stages, namely Bridge-in, Objective, Pre-assessment, Participatory Learning, Post-assessment, and Summary, into a closed-loop teaching system. The key characteristics of the model include a student-centered approach, modular teaching, timely feedback and adjustment, as well as comprehensive assessment.

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Teaching Challenges in *Food Nutrition and Health*

As an important interdisciplinary or specialized course, the core value of *Food Nutrition and Health* lies in guiding students to apply knowledge of food nutrition to lead scientifically healthy lives, thereby helping them appreciate the crucial role of human development and technological advancements in safeguarding life and health[7]. Therefore, this course serves as a key vehicle for disseminating nutrition and health knowledge, enhancing public scientific literacy in nutrition and health, and cultivating interdisciplinary talents equipped with expertise in both nutrition and health fields. However, the traditional lecture-based teaching model of "teacher speaks, students listen" in the *Food Nutrition and Health* course faces numerous challenges in practice. First, there is a disconnect between abstract content and practical application. Theoretical explanations on topics such as nutrient metabolism and physiological functions tend to be dull, making it difficult for students to effectively link abstract concepts with daily dietary choices and personal health management. Second, students lack a sense of engagement. In large-class teaching conditions, students passively receive information with limited opportunities for active thinking and practical application, resulting in low classroom dynamism. Teachers often rely on monotonous and uninspiring lecture methods, which fail to stimulate interest or initiative, leading to low student engagement. Third, the learning evaluation methods are overly simplistic. Over-reliance on final written examinations makes it difficult to comprehensively assess students' ability to apply knowledge, critical thinking skills, and shifts in health behavior intentions. Additionally, there is a lack of learning motivation. Many students perceive the course as weakly connected to their personal lives, resulting in insufficient driving force for sustained and in-depth learning.

Specific Implementation of the BOPPPS Teaching Model in the *Food Nutrition and Health* Course

Taking Section 2 of Chapter 2, "Lipids", from the textbook *Food, Nutrition and Health* edited by Hu Min and Zhou Xiaojun as an example, the teaching design for each stage is outlined below.

Bridge-in

The lesson is introduced by playing a short documentary video from daily life (*e. g.*, a fitness enthusiast developing fatty liver due to a low-fat diet). Before showing the video, questions related to the video content are posed to the students. For example: "Why did a fitness enthusiast who eats boiled chicken breast and vegetables daily develop moderate fatty liver? Is the hidden culprit the salad dressing, protein powder, or a metabolic trap?" By watching the video with these pre-set questions, students can effectively experience cognitive conflict, thereby igniting their motivation to learn.

Using a short video as the introduction, students' cognitive focus can be quickly centered. This method connects course content with personal life experiences and scientific phenomena, bridges prior and new knowledge, and stimulates deep curiosity and problem awareness. It also lays a cognitive foundation for subsequent knowledge construction.

Objective

Clear, specific and measurable learning objectives form the cornerstone of teaching design. It is essential to explicitly articulate what students will "be able to do" upon completion of this segment. Objective setting must adhere to the "student-centered" principle, employing action verbs to clearly define competency outcomes. Relying on action verbs facilitates student self-assessment. Furthermore, it is essential to ensure that objectives are based on a comprehensive analysis of students' learning context and remain within their achievable range. For example, visualizing the learning objectives of this chapter in the PPT helps students grasp the key points of "Lipids". The objectives for the first section of "Lipids" are as follows:

(1) Knowledge objective: Students should be able to articulate the concept of lipids and explain the hazards and sources of trans fatty acids. Moreover, they shoule be able to create a knowledge map of fat types while annotating primary food sources, and identify key sites of lipid digestion and absorption.

(2) Skill objective: Students should be able to calculate fat content and propose healthier alternatives (*e. g.*, nut yogurt instead of milk tea). They should also be able to accurately identify dietary sources of fats.

(3) Affective attitude and values objectives: Students develop the ability to critically examine trans-fatty acid data in trending online foods, for instance, through cross-referencing reports from the National Center for Food Safety Risk Assessment, thereby cultivating a holistic perspective on food, nutrition, and health.

Pre-assessment

Before introducing new teaching content, methods such as quick questionnaires, concept maps, brainstorming, or multiple-choice questions can be used to rapidly gauge students' existing knowledge, misconceptions, or points of interest. This enables instructors to promptly adjust teaching priorities and strategies based on students' actual situations. Prior to explaining the concept of trans-fatty acids, a brief quiz can be conducted using Rain Classroom's visual voting matrix. For example: "Where is the primary site of fat absorption? What is the daily intake limit for trans-fatty acids recommended by the Dietary Guidelines? Which of the following foods contains the highest levels of trans fatty acids?" Alternatively, fragmented and scrambled digestion flowcharts can be distributed via the Xuexitong software, requiring students to complete a "digestion pathway puzzle" game. Through visual data analysis, teachers can gain insight into students' knowledge levels and perspectives. Students with low response rates or incorrect

answers should be given continued attention in subsequent teaching sessions.

Participatory learning

Participatory learning is the core component of the BOPPPS teaching model, designed to shift students from passive receivers to active constructors of knowledge. This phase requires instructors to thoughtfully design a variety of interactive activities, such as group discussions, case analyses, role-playing, simulated experiments, instant surveys, short presentations, and online interactions, so as to prompt students to actively process information, apply knowledge, solve problems, and engage deeply in the learning process.

Building on a solid foundation of knowledge about trans-fatty acids, students can be guided to engage in a role-playing activity titled "Trans-fatty Acid Tracers". Four roles are available for students to choose from: food consumer, nutritionist, food manufacturer, and regulatory inspector. Each student is required to develop a specific scenario based on their selected role (*e. g.*, a consumer selecting snacks, a manufacturer designing a product formula, a nutritionist creating a dietary plan, or an inspector reviewing food labels). By simulating decision-making behaviors in real-world scenarios, such as consumers comparing packaging labels, manufacturers selecting types of oil, and regulators testing food ingredients, students can delve into the processes of trans-fatty acid intake or production involved in these actions. They can then trace the specific chain of health impacts resulting from these behaviors, for example, using hydrogenated vegetable oil in biscuits → increased trans-fatty acid content → elevated LDL cholesterol caused by long-term consumption → heightened risk of cardiovascular disease. The instructor circulates among all discussion groups throughout the activity, posing targeted questions such as, "What does the position of non-dairy creamer' on the ingredient list indicate?" and "How can hidden sources of trans-fatty acids be identified?" The aim is to guide students toward key learning points. Particular emphasis is placed on skills for interpreting food labels and the regulatory requirements outlined in *General Rules for Nutrition Labeling of Prepackaged Foods*. When discussing health impacts, real scientific data can be introduced, such as the WHO report stating that trans fat causes 500 000 deaths annually. Students are asked to reflect on the ethical responsibilities associated with their respective roles based on this data, with a particular focus on analyzing the potential public health crises that could arise from food manufacturers' "false labeling of zero trans fat" or consumers' "neglect of nutrition labels".

Through role-playing, students gain a deeper understanding of the sources and harms of trans-fatty acids. Meanwhile, they come to recognize that scientific transparency in food information is not only a legal requirement, but also a social responsibility. This approach elevates knowledge acquisition to the cultivation of civic awareness regarding food safety.

Students' enthusiasm and initiative are stimulated by employing these engaging methods, encouraging their active participation in activities and facilitating deep learning. This approach also enhances students' understanding and application of knowledge, sharpens their critical thinking, problem-solving ability, and collaboration skills, ultimately laying a solid foundation for achieving the teaching objectives.

Post-assessment

The post-assessment phase is designed to promptly evaluate the achievement of learning objectives. This phase must closely align with the learning goals and pre-assessment outcomes and is flexible in format. Instructors may use in-class quizzes, assigned reflection questions, one-minute questionnaires, concept map refinement, skill demonstration, or solving a new case study to assess whether students have met the preset learning objectives. This process evaluates students' knowledge mastery and application, providing timely feedback for both instructors and learners. After completing the content on lipids, questions can be posed for students to express their views. Examples include: "What are the hazards and sources of trans-fatty acids?" and "Which foods in daily life contain hydrogenated vegetable oils?" Based on the assessment results, teachers can promptly engage in teaching reflection and adjustment, optimizing instructional design to more effectively achieve the teaching objectives.

Summary

The summary phase of the BOPPPS model serves as the cognitive closure of classroom teaching, aiming to facilitate students' independent consolidation and internalization of knowledge into a structured framework. Instructors, together with students, review key knowledge points and skills, highlight critical and challenging content, and establish a coherent knowledge architecture. At this stage, the instructor transitions from being a knowledge transmitter to a facilitator. Specifically, students are asked to independently or collaboratively outline the core content framework of the lesson and simultaneously conduct a self-assessment of their learning outcomes. For example, students may be tasked with creating a mind map that summarizes key concepts related to lipid metabolism, including its classification and functions. The instructor then summarizes and synthesizes the key points of the lesson, assigns extended thinking or practical tasks, and sets the stage for the next class. Through students' independent organization of the learned content, this phase enhances their critical thinking and self-directed learning abilities.

Conclusions

In this study, the BOPPPS teaching model was integrated into the instructional design and practice of the *Food Nutrition and Health* course. The model effectively strengthens the connection between theoretical knowledge and real-life scenarios, significantly enhancing student engagement, knowledge application skills, and

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modeling. Future work will focus on extending this framework to more quality indicators and crop varieties, while further optimizing model efficiency to meet the real-time requirements of online detection.

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overall competencies. Of course, teaching reform is a continuous process that requires teachers to invest considerable effort and dedication to continually refine and optimize the application of the BOPPPS model in the *Food Nutrition and Health* course. It holds significant reference value for the teaching reform of general education and specialized courses that are closely linked to life practices. In the future, further exploration is needed in areas such as the deep integration of information technology, the introduction of authentic real-world scenarios, the establishment of long-term evaluation mechanisms, and the continuous empowerment of educators, in order to drive ongoing optimization of teaching reform outcomes and the sustained enhancement of talent cultivation quality.

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