ISSN: 2637-6067 DOI: 10.6918/IJOSSER.202510_8(10).0029

AI Empowerment of the "One Body, Two Wings" Teaching Model in *Brain and Cognitive Science*

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Abstract

This paper explores the AI-powered teaching reform model for *Brain and Cognitive Science* in the Computer Department at Foshan university. Combining the latest developments in Artificial Intelligence (AI) and its pervasive impact, this paper proposes the "One Body, Two Wings" AI empowerment model. The core of this model includes the integration of state-of-the-art AI knowledge, online and offline resources, and a focus on the learning process. This paper summarizes the advantages of this model in enhancing students' professional abilities and perspectives, reflecting the "student-centered" teaching philosophy.

Keywords

Artificial Intelligence; Brain Science; Cognitive Science; Teaching Reform.

1. Introduction

In recent years, Foshan University has offered the course *Brain and Cognitive Science* in the second semester of the sophomore year of the Computer Department. The goal of this course is to explore the integration model of Artificial Intelligence (AI) with brain science and cognitive science, further promoting the design of human-like algorithms, and cultivating interdisciplinary talents that meet the needs of the times. With the development and integration of fields such as brain science, cognitive science, computer science, AI, and robotics, the teaching of *Brain and Cognitive Science* also needs to keep pace with the latest developments, thereby stimulating students' enthusiasm for learning and improving learning outcomes[1].

2. The Relationship Between Artificial Intelligence and This Course

2.1. Characteristics of Artificial Intelligence

Artificial Intelligence (AI) was born in 1956 with the goal of enabling machines to possess human-like intelligence. However, in the first few decades, its development was full of ups and downs. In recent years, with the rise of deep learning algorithms and advances in hardware resources, AI has developed rapidly and penetrated various fields, including image processing, speech recognition, product recommendation, and autonomous decision-making for robots. The emergence of ChatGPT also marked the beginning of a new era in generative artificial intelligence[2].

Unlike fields like medicine and life sciences, whose goal is to explore the fundamental principles of brain science and cognitive science, computer science, on the other hand, is based on the research outcomes of these fields and uses AI algorithms to empower intelligent systems, such as robots, to simulate human-like intelligence. Therefore, AI programs act as a bridge connecting computer science with brain science and cognitive science. The ultimate goal is to "simulate the brain, approximate the brain, and surpass the brain", helping scientists better

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understand the brain and facilitating the shift of society from "manufacturing" to "smart manufacturing".

2.2. Mission of This Course

In fact, the European Union and the United States launched their own "Human Brain Project" in 2010 and 2013, respectively, with substantial financial investment. Therefore, the "Human Brain Project" has become a new form of national high-tech competition, both a challenge and an opportunity, which has further encouraged the development of the *Brain and Cognitive Science* course in computer-related majors in universities[3]. This course is characterized by its interdisciplinary and state-of-the-art nature, and our country urgently needs a large number of computer talents who can collaborate with researchers in brain science and cognitive science.

However, textbooks must go through stages such as writing, review, publication, and distribution. Thus, their inherent lag is in conflict with the state-of-the-art nature of this course. For example, AI researchers receiving the Nobel Prize in Physics and Chemistry in October 2024 for their groundbreaking work cannot be reflected in the textbooks currently in use. Yet, the knowledge behind these events is closely related to brain science, cognitive science, and artificial intelligence, sparking strong curiosity and a desire for knowledge among students. Therefore, in addition to teaching the fundamental principles of brain science and cognitive science based on textbooks, the teachers also need to prepare lectures based on current AI hot topics and challenges to ensure effective learning. In summary, the *Brain and Cognitive Science* course for computer-related majors should be guided by the latest developments in AI, aiming to cultivate technical talents with a solid foundation, an understanding of state-of-the-art topics, strong practical abilities, a willingness to learn new knowledge, and a proactive and confident attitude.

3. AI Empowerment in the Teaching Reform of Brain and Cognitive Science

The computer major at Foshan University is a national first-class undergraduate major, focusing on training technical talents in fields such as computer science and intelligent systems for design and development. With strong support from Foshan university, the Computer Department, the *Brain and Cognitive Science* course team, guided by ideological education and based on textbooks, has actively explored AI empowerment solutions. After several years of effort, a "One Body, Two Wings" AI empowerment model has been developed. This model is centered on state-of-the-art knowledge (the body), integrates offline and online resources (the wings), and emphasizes the learning process (the wings). The focus is on cultivating high-quality computer talents who can connect theory with practice and adapt to technological advancements.

The overall model of AI empowerment in *Brain and Cognitive Science* is shown in Figure 1. While mastering professional knowledge, students also gain an understanding of the rapid development of national high-tech fields, thereby strengthening their confidence and cultivating a practical scientific spirit.

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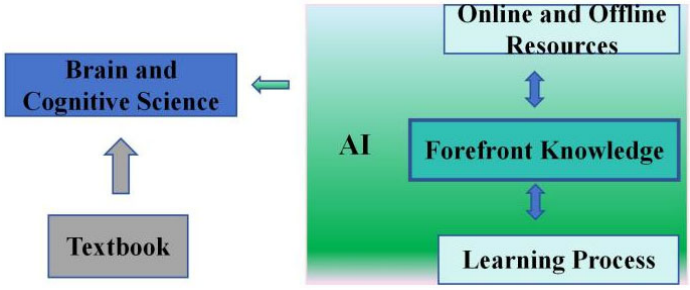

Figure 1. The "One Body, Two Wings" AI Empowerment Model for *Brain and Cognitive Science*

3.1. Based on the Forefront Knowledge

This course mainly includes two aspects: one is the basic knowledge of brain science and cognitive science, and the other is the state-of-the-art knowledge of AI. The former is based on the selected textbooks, while the latter consists of materials collected by the teachers through the internet, or self-prepared lectures, videos, and bilingual materials. These English-language materials, which have not been translated into Chinese, allow students to experience the most authentic knowledge. Of course, the teachers rigorously review these English materials to ensure academic purity and also encourage students to read English directly.

The current trend is interdisciplinary, integration, and innovation. Thus, the frontier dynamics of the course knowledge does not exist in isolation. Combining case studies with state-of-the-art technologies allows students to feel the value of knowledge, thus further enhancing their learning interest. For example, with ChatGPT, although it has received a lot of media coverage, the reports are often repetitive and incomplete. Therefore, the teachers need to collect original papers, videos, interviews, and other resources to help students deepen their understanding of it from multiple sources. Instructors must carefully curate this knowledge, helping students filter out overly complex details while guiding them to delve deeper into some aspects of it.

The teaching effect of incorporating state-of-the-art technology involves two aspects: the teachers' observations and students' feedback. Teachers have noticed that after taking this course, students are more willing to discuss technology news with students from other majors and teach them to analyze media reports, videos, and images from a professional perspective. Survey results show that students feel that their learning motivation and sense of achievement have significantly improved. "Top-down" means keeping up with the forefront of the times and understanding the secrets of state-of-the-art technologies. "Solid-ground" means students themselves can also write corresponding programs and gradually simulate complex natural phenomena. Relatively, students' exam results in this course are often better than in other courses during the same semester.

3.2. Blending Offline and Online Learning

This course adopts a blended teaching model, combining offline and online resources. The offline model remains the traditional teaching method, with classroom instruction combined with key case studies. The online model includes platforms such as WeChat official accounts, video courses, and WeChat groups. One of the advantages of video courses is that students can repeatedly watch and reflect on them. The blended offline and online teaching style fosters a sense of "the teacher is always by my side" in students. In the internet age, students are often exposed to new knowledge, but due to a lack of sufficient foundational knowledge, they are prone to confusion or even misguidance. For example, can DeepSeek and ChatGPT really replace writers? Do students still need to learn writing and programming? If professional teachers provide timely guidance, students will have a high learning enthusiasm as they strive to master these new tools[4].

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Case-based teaching is one of the main teaching styles in this course. For example, students are guided to write corresponding programs based on popular topics such as ChatGPT, AlphaGo, and fake videos, reflecting the changes of cognitive processes. Taking AlphaGo as an example, it has a broader fan base than ChatGPT or LORA because almost everyone has experienced the joy of playing chess and the hardware requirements are not very high. To fully understand AlphaGo, the instructor explains reinforcement learning and its classic algorithms in detail, and requires students to work in pairs to simulate AlphaGo's self-learning process.

3.3. Emphasizing the Learning Process

The *Brain and Cognitive Science* course has a strong theoretical and practical nature, but the final exam usually only tests theory, which leads students to neglect the practical aspects. Therefore, if more attention is given to the learning process and practical programming assessments are increased, it will help students focus on simulating the brain, approaching the brain, and even surpassing it through programming, further reflecting "interdisciplinary integration". For example, state-of-the-art topics like ChatGPT and fake videos can be used as teaching cases to guide students to engage in programming practice in stages. This course emphasizes the management of the learning process and conducts timely assessments of each key knowledge point. The main form of assessment is group presentations and defenses, where students need to use programming to simulate the brain's functions such as "knowledge adaptation", and display the cognitive process through curve graphs.

Practical experience shows that process management helps to divide the course teaching objectives, explore specific quantifiable methods, and make it easier for students to perceive their learning progress, thereby enhancing their sense of achievement. On the other hand, the ultimate goal of brain science and cognitive science is to unlock the mysteries of the brain. Their development is influenced by fields such as neuroscience, AI, computer science, and mathematics, and any development in one field affects the development of brain science and cognitive science.

3.4. Others

In addition to conventional AI programs, further expansion of analysis on news events is also required. Take AlphaGo for example, people also care about this question: Is it still possible for human players to win against AlphaGo in the field of Go? There is no standard answer to this question, but students need to answer it based on their knowledge of AI, and their answer reflects their understanding of the knowledge.

4. Conclusion

Offering the *Brain and Cognitive Science* course in computer-related majors aligns with the current trend of interdisciplinary and integrative advancements in state-of-the-art technologies and meets the psychological needs of students. The AI empowerment model of the *Brain and Cognitive Science* course is based on forefront knowledge, with offline and online teaching models and learning process management acting as the two wings[5].

Teaching experience shows that integrating forefront knowledge into this course stimulates students' curiosity and desire to explore. It helps promote learning from multiple dimensions, boost students' confidence, and improve teaching effectiveness. This approach embodies the "student-centered" teaching philosophy. On the other hand, the challenge of incorporating forefront knowledge lies in designing suitable and implementable programming cases, guiding students to complete programs step by step, and promptly addressing their questions and doubts. In this way, students can keep pace with the technological era and enhance their cultural confidence.

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Acknowledgments

Fund: Guangdong Province Undergraduate University Teaching Quality and Teaching Reform Engineering Construction Project: "Teaching Reform and Practice of Brain and Cognitive Science Based on the 'One Body, Two Wings' Model" (Yue Jiao Gao Han [2024] No. 9); "Research on the Exploration and Practice of Talent Cultivation Models for Innovation and Entrepreneurship in Electronics Majors at Local Universities Driven by the 'Four New' " (Yue Jiao Gao Han [2024] No. 30). Foshan University AI Course Construction: "Brain and Cognitive Science"([2025] No. 9). Foshan University Bilingual Course: "Brain and Cognitive Science" ([2019] No. 20).

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