Practice of Integrating Natural Science Works into College Education

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Abstract. This paper explores the integration of classic works in natural sciences into university education, analyzing how these classics promote critical thinking, scientific literacy, and interdisciplinary understanding. It discusses the process of incorporating these works into modern teaching, assesses their educational impact, and addresses the challenges encountered during implementation. The research reveals that appropriate teaching strategies can effectively integrate natural science classics into university education, fostering students' innovative thinking and creative problem-solving abilities.

Keywords: Natural science classics, scientific literacy, scientific thinking, interdisciplinary education.

1 Introduction

In recent years, university education has increasingly focused on integrating interdisciplinary and reflective learning, especially within the natural sciences. These fields typically emphasize practical application but often neglect the historical and philosophical foundations of scientific discoveries [1, 2]. Natural science classics refer to influential original academic works in natural sciences, typically written by historically significant scientists. These works discuss scientific theories, experimental methods, and groundbreaking discoveries, not only laying the foundation for modern science but also profoundly shaping the development of subsequent scientific research. Examples include Newton's Philosophiae Naturalis Principia Mathematica and Darwin's On the Origin of Species, which are indispensable in fields such as physics, biology, and other natural sciences.

Studying natural science classics offers students a unique opportunity to engage with original materials, helping them understand the evolution of scientific methods and theories. Rather than relying solely on simplified textbook summaries, students are exposed to the complexities of these foundational theories through classic works by figures like Newton, Einstein, and Darwin. This approach not only helps students grasp

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the formation process of scientific theories but also cultivates critical thinking and analytical skills. Furthermore, the historical and cultural contexts embedded in these works allow students to better understand the intersections between science and other fields of human thought, particularly philosophy and ethics.

This paper aims to explore how natural science classics can be effectively integrated into undergraduate curricula, analyzing the educational benefits and addressing the challenges faced during implementation. Through case studies and practical educational experiences, the research demonstrates how classic scientific works can promote critical thinking, scientific literacy, and interdisciplinary learning among students.

2 The Role of Natural Science Classics in Undergraduate Teaching

In *The Structure of Scientific Revolutions*, Thomas Kuhn argues that scientific progress is non-linear and is achieved through paradigm shifts [3]. The works of Newton, Galileo, and Darwin exemplify these shifts, providing students with insights into the evolution of scientific knowledge. By studying these classics, students not only learn about the final outcomes of scientific discoveries but also gain an understanding of the thought processes and experimental methods used by early scientists.

Research on educational practices shows that reading original texts can significantly enhance students' critical thinking abilities. Engaging with classic works requires students to analyze complex ideas, interpret historical contexts, and connect past knowledge with current scientific paradigms. For instance, by studying Darwin's On the Origin of Species, students can gain a deeper understanding of the development of evolutionary theory and its impact on both society and science. This experience helps cultivate a more nuanced appreciation of the complexities involved in scientific discovery.

Educational theorists such as Jerome Bruner and John Dewey emphasize the importance of contextual learning, suggesting that students gain a better understanding of scientific theories when they are aware of the historical and social contexts in which those theories were developed [4,5]. Natural science classics offer students rich historical backgrounds, enabling them to see science as a dynamic process shaped by time and place rather than as a collection of fixed facts. By introducing these works into undergraduate education, students can better understand science as a human endeavor, involving trial and error, debate, and the reinterpretation of knowledge.

For example, Newton's Philosophiae Naturalis Principia Mathematica not only provides a foundation for physics but also reveals how scientific ideas were disseminated and challenged in historical and social contexts. By studying this text, students can explore the history of scientific debate and gain a better understanding of how scientific ideas spread and evolved.

3 Case Study

An effective strategy for integrating natural science classics into undergraduate education is incorporating these works into general education courses. These courses combine science, history, and philosophy, helping students explore the broader impact of scientific thought. Courses such as "History and Philosophy of Science" or "Scientific Revolutions and Their Societal Impact" provide structured environments for discussing classic works in relation to modern scientific concepts. Another approach involves dedicated seminars or electives, where students read original classics, write analytical essays, or engage in group discussions to critically examine the contribution of these works to modern science.

In line with these approaches, the author's institution has established a general education course titled Introduction to Natural Science Classics. This interdisciplinary course blends History of Science and Philosophy of Science, addressing the tendency in STEM education and general education to focus on specifics while overlooking the broader picture. As shown in Table 1, the course follows the themes of "scientific knowledge, scientific thinking, scientific methods, and the spirit of science" through in-depth readings of eight key classic works from fields such as Greek philosophy, physics, life sciences, and scientific methodology. The course aims to help students understand the origins, historical development, and future trends of natural science. Additionally, it introduces students to the structure of scientific disciplines and the roles various specialties play, encouraging them to develop scientific thinking and research methods.

Table 1. Selected Books, Main Content, and Teaching Goals of ***Introduction to Natural Science Classics***

Classic Work	Athor	Main Content	Teaching goals
The Republic	Plato	Discusses the Allegory of the Cave and Plato's concept of the two worlds.	Develop students' critical thinking skills.
The Beginnings of Western Science	David C. Lindberg	Explores the historical development of Western scientific thought from ancient Greece to the Middle Ages.	Help students understand the evolution of science and its cultural impacts
Philosophiae Naturalis Principia Mathematica	Isaac Newton	Discusses the historical background of Newton's three laws of motion and the law of universal gravitation; A milestone in the mathematization of physics and the scientific revolution.	Improve scientific thinking skills, particularly in analyzing and solving mathematical and physical problems.
Relativity: The Special and the General Theory	Albert Einstein	Explores ancient and modern views on space-time, the shift from classical physics to theoretical physics represented by relativity,	Cultivate students' knowledge of science, scientific thinking, scientific methods,

		and the evolution of scientific paradigms.	and the spirit of science.
On the Origin of Species	Charles Darwin	Proposes and argues for the theory of evolution and natural selection; Explores the process of life's evolution and the mechanisms of biological adaptation.	Enhance scientific literacy and critical thinking in the field of biology.
DNA: The Secret of Life	James D. Watson	The discovery of DNA's structure and its revolutionary impact on modern genetics; The development and applications of genetic technology, such as genetic engineering and medical innovations.	Equip students with scientific inquiry skills, particularly in the life sciences.
The Astonishing Hypothesis: The Scientific Search for the Soul	Francis Crick	Explores the relationship between consciousness and brain activity; Attempts to scientifically explain the connection between the mind and the brain.	Teach students how to approach research in fields considered difficult to study.
Science and Hypothesis	Henri Poincaré	Discusses the construction of scientific theories and their mathematical foundations; Examines hypothetical questions in geometry, physics, and the philosophy of science.	Improve students' scientific reasoning, especially in applying mathematics and physics.

4 Course Outcomes

(1) Enhanced Critical Thinking

The classic works require students to critically analyze the development of scientific theories, greatly contributing to the cultivation of critical thinking. For example, when reading Newton's Philosophiæ Naturalis Principia Mathematica, students must not only understand the logical reasoning but also consider the historical context, which helps develop more complex thinking and awareness of the dynamic and evolving nature of scientific knowledge.

(2) Fostered Scientific Literacy

The classics provide not only scientific knowledge but also demonstrate science as an ongoing process of inquiry. For instance, by studying Darwin's *On the Origin of Species*, students gain insights into the development of evolutionary theory and how scientific theories evolve through experimentation, observation, and revision. This understanding helps students recognize the cumulative and evolving nature of scientific knowledge.

(3) Developed Interdisciplinary Skills

Classic works provide rich resources for interdisciplinary education. Many of these texts go beyond scientific theory, addressing philosophical, ethical, and even literary issues. For example, Galileo's works explore philosophical questions about the nature

of knowledge, while Darwin's theory of evolution raises ethical and religious discussions. Through these texts, students can explore the intersections of science and other disciplines, fostering interdisciplinary critical thinking.

(4) Stimulated Innovation and Creativity

Classic works highlight revolutionary moments in the history of science, showing how scientists broke with existing paradigms and proposed new ways of thinking. By studying these classics, students learn how some of the most innovative thinkers in history faced challenges, drawing inspiration and stimulating their own creative thinking.

5 Challenges and Solutions

(1) Language and Content Difficulty

The language and content of classic works may be difficult for modern students to grasp. To address this, we adopted a progressive learning approach, breaking down complex texts into manageable parts and providing guiding questions or supplementary materials. Annotated versions of the classics, combined with modern commentaries, help students place the original works in context and understand their relevance to modern science. Small group discussions also offer opportunities to clarify difficult concepts and engage with the material more deeply.

(2) Perception of Classics as Outdated

Some students and teachers may perceive these classic works as outdated or irrelevant to modern scientific practice. To overcome this resistance, we emphasize the importance of understanding the historical development of scientific thought and demonstrate how the foundational ideas in these works continue to shape and influence contemporary scientific research. By linking classic discoveries to current scientific challenges, teachers can show how early scientists' methods, reasoning, and theories remain relevant today.

6 Conclusion

Incorporating natural science classics into undergraduate education enhances students' critical thinking, scientific literacy, and interdisciplinary understanding. These classic works not only laid the foundation for modern science but also illustrate science as a dynamic process of inquiry and knowledge construction. By studying original works from figures such as Newton, Galileo, and Darwin, students gain a deeper understanding of the complexity of scientific discovery and develop an interdisciplinary perspective. As the boundaries between disciplines continue to blur, studying these foundational works will play a crucial role in preparing students to navigate the complexities of the 21st century.

Declaration of generative AI and AI-assisted Technologies in the Writing Process

During the preparation of this work the authors used ChatGPT in order to improve language and readability. After using this tool/service, the authors reviewed and edited the content as needed and take(s) full responsibility for the content of the publication.

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