

Construction and Practice of a Curriculum Ideological-Political Case Database for General Biology in the Context of Digital-Intelligence Empowerment

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Abstract

The curriculum ideology and politics is the key to combine value guidance naturally with subject teaching. However, courses for science technology faced some problems, such as insufficient exploration of ideological and political elements, monotonous teaching methods, and rigid integration with professional knowledge. They have severely limited educational effectiveness. Therefore, we used *General Biology* as an example to identify the ideological-political values, such as scientific spirit, patriotism, ecological awareness, professional ethics, and philosophical reasoning in this study. The knowledge graphs and other digital tools were used to construct a structured, tag-based, and continually updated digital case library.

Keywords

Curriculum ideology and politics; *General Biology*; digital and intelligent empowerment; case database construction; knowledge graph.

1. Introduction

There is not optional between curriculum-based ideological and political education. We fulfill higher education's deeper purpose [1]. According to the Guidelines for Higher Education Institutions, "ideological and political resources in all courses and teaching methods" are required [2]. Through this effort, we aim to equip students with a deeper understanding of social principles, a clearer worldview, broader knowledge, and stronger character. There are four interconnected domains across ideological education including disciplinary content, teaching methods, textbook development, and management systems [3]. However, we should find the best way to combine these value-oriented elements into subject teaching. Achieving the organic unity of knowledge delivery and value guidance has thus become a key challenge in higher education reform today.

We are currently in the digital intelligence era, an age defined by digitalization and intelligentization. Technologies such as big data, cloud computing, and artificial intelligence have greatly facilitated the organization, storage, retrieval, and delivery of teaching resources. In curriculum-based ideological and political education, a pressing question is how to use these technologies to overcome the common dilemmas of traditional materials such as superficial mining, monotonous presentation, and fragmented application. In response, some universities have begun to explore knowledge graphs combined with AI agents. Their goal is to build a "knowledge, ability, value" integrated cultivation system.

General Biology is a foundational course for biology-related majors in science, agriculture, and teacher education. It serves as a key platform for building students' knowledge of life sciences. It is also an important vehicle for education in the view of nature. The course covers a multi-level body of knowledge, ranging from cells to biological taxa. It is highly systematic and dense

in content. At the same time, it contains rich life philosophies, vivid scientific historical facts, elements of traditional Chinese culture, and a profound scientific research spirit. However, the current ideological-political education in *General Biology* faces practical difficulties. These include insufficiently deep mining of materials, monotonous presentation, and rigid integration with professional knowledge. How to systematically extract the ideological-political elements from this course and, with the help of digital-intelligence technologies, achieve structured, digital, and dynamic construction of case resources is the core question that this paper addresses.

2. Practical Dilemmas in Curriculum-based Ideological and Political Education for General Biology

2.1. Lack of Systematicity in Mining Ideological-Political Elements

General Biology covers a wide range of knowledge, from biomolecules to ecosystems. However, current efforts to mine ideological-political elements are mostly fragmented. They tend to be isolated efforts by individual teachers, rather than a systematic review of the entire course framework. Science technology courses should require a more systematic approach as well as recommend "sorting out knowledge points" across the entire process [4]. Their observation is consistent with our practical experience.

2.2. Rigid Integration of Ideological-Political Materials with Subject Knowledge

Courses of biotechnology which are logically and practically are considered as less relevant to ideological-political content. In our teaching process, some problems such as some instructors treat value integration as a separate step have been found. For example, teachers added the ideological political elements at the end. It was considered as "label-sticking," creating a disconnect. The "two skins" phenomenon may cause resistance of students.

2.3. Monotonous Presentation Formats and Lack of Technological Support

Ideological-political teaching in *General Biology* is mostly depended on lectures or PowerPoint slides currently. They are static. There are few Interactive or immersive elements. However, students growing with digital media like short videos, visual content, and interactive formats better [5]. There is another problem that we have no systematic platform to store these materials. When we prepare a lesson, it is time-consuming and labor-intensive. It is difficult to realized personalized or precise teaching.

2.4. Lack of Dynamic Updating and Sharing Mechanisms for Case Resources

Biology is developing rapidly with scientific progress and new breakthrough. However, ideological and political resources are still static without update. Therefore, there is few currency and relevance. They no longer reflect cutting-edge research or real-world debates. Across universities, sharing is fragmented at best. Teachers duplicate each other's work without knowing it, leading to considerable waste of effort.

3. Pathways for Constructing a Digital-Intelligence-Enabled Curriculum Ideological-Political Case Database

To address the above dilemmas, this paper proposes a pathway for constructing a digital case database for *General Biology* based on digital-intelligence technologies, which includes systematic mining of ideological-political elements, multi-dimensional tagging of cases, construction of a digital-intelligence platform, and establishment of dynamic updating mechanisms.

3.1. Systematically Mining Ideological-Political Mapping Points and Building Multi-Dimensional Educational Dimensions

The project team conducted a comprehensive review of the knowledge system of *General Biology*, deconstructing the course content along the knowledge thread of “biomolecules → cells → tissues and organs → individuals → populations and communities → ecosystems → biological evolution,” and deeply explored potential ideological-political mapping points in each knowledge module [6]. Specifically, the work was carried out along the following five dimensions:

(1) Scientific spirit dimension

We identified major discoveries and scientific breakthroughs in the history of biology, such as the proposal of Darwin’s theory of evolution, the discovery of the double-helix structure of DNA, and the emergence of gene-editing technology, to guide students in appreciating the hardship and charm of scientific exploration and cultivating a truth-seeking, innovative scientific spirit.

(2) Patriotism dimension

We focused on the moving stories and outstanding contributions of Chinese biologists, such as Tong Dizhou’s pioneering work in experimental embryology and Yuan Longping’s dedication to hybrid rice research, to stimulate students’ national pride and sense of mission to serve the country through science and technology.

(3) Ecological civilization dimension

We integrated content on ecology, biodiversity conservation, and environmental pollution control to help students understand the profound meaning of “clear waters and green mountains are as valuable as gold and silver mountains,” and to establish a worldview that respects, conforms to, and protects nature.

(4) Professional ethics dimension

We addressed ethical controversies and social impacts of biotechnology, such as the ethical boundaries of gene editing, risk prevention and control in biosafety, and the bottom-line requirements of research integrity, to cultivate students’ professional ethical awareness and social responsibility.

(5) Philosophical thinking dimension

We explored the dialectical materialism contained in biological knowledge, such as the dialectical relationships between whole and part, structure and function, heredity and variation, and homeostasis and imbalance in living systems, to foster students’ philosophical thinking and scientific literacy.

3.2. Applying Knowledge Graph Technology to Structure and Tag Cases

On the basis of systematic mining, the knowledge graph technology was introduced to structurally organize and multidimensionally tag each ideological-political case.

Firstly, we constructed a knowledge graph framework for *General Biology*, systematically organizing course knowledge points by hierarchical relationships and logical connections to form a knowledge network covering the entire course. Then, we precisely linked the mined ideological-political cases with corresponding knowledge points, clarifying the knowledge module, ideological-political dimension, difficulty level, and teaching scenario for each case.

Secondly, we assigned a multi-dimensional tag system to each case, including: ① knowledge tags (specific course knowledge points or chapters); ② ideological-political dimension tags (scientific spirit, patriotism, ecological civilization, professional ethics, philosophical thinking, etc.); ③ case type tags (scientific historical facts, character stories, social hotspots, ethical controversies, policies and regulations, etc.); ④ teaching scenario tags (pre-class preview,

in-class lectures, group discussions, after-class extension, etc.); and ⑤ difficulty level tags (basic, intermediate, advanced).

As demonstrated by the practice at Sichuan University, knowledge graphs could organize knowledge points into a “logically rigorous and hierarchical network,” enabling students to “understand things more effectively.”

3.3. Building a Multi-Modal Digital Case Resource Platform

To break the limitation of monotonous presentation, efforts were devoted by the project team to building a multi-modal digital case resource platform. The platform integrates various media formats such as text, images, audio, video, animation, and virtual simulation, to form a three-dimensional and immersive case presentation system.

Specifically, platform resources include text-based resources, such as the scientific history literature, biographies, policy documents, news reports, etc.; image-based resources, such as historical photographs, scientific images, data charts, infographics, etc.; video-based resources, such as clips from science documentaries, expert interviews, experimental demonstrations, animated simulations, etc.; and interactive resources, such as virtual simulation experiments, interactive Q&A, scenario simulations, role-playing, etc. The multi-modal presentation satisfies the needs of students with different learning styles and enhances the attractiveness and emotional impact of case teaching.

3.4. Establishing Mechanisms of teaching, feedback and update

The mechanism of teaching, feedback and update has been constructed.

(1) Teaching feedback mechanism

After each case is taught, teachers log onto the platform. They record how the lesson went, what students said, and what could be improved. These records then guide us in revising and updating the case.

(2) Case collection mechanism

The submission mechanism has been set up. Teachers could upload new cases which they encounter during their daily teaching. This mechanism ensures a steady flow of new resources.

(3) Hot-topic tracking mechanism

Our team tracks the latest research, social hotspots, and current events in the life sciences on a regular basis. When we identify a relevant topic, we developed a corresponding case or revised an existing one. This practice ensures that the database remains up to date.

(4) Inter-institutional sharing mechanism

Once the database is more fully developed, we intend to promote it to other programs both on and off campus. We will use teaching seminars, teacher training sessions, and resource exchange meetings as platforms in order to spark collaboration and encourage experience sharing across institutions.

4. Construction Outcomes and Reflection

After several rounds of development and testing, we have built a preliminary version of the digital case database for General Biology. The results so far are encouraging. Progresses could be summarized as follows.

(1) The case collection has moved from fragmentation to systemization.

Currently, the database contains over 20 cases. These cases cover the full range of course knowledge modules. They also reflect all five ideological-political dimensions we identified. These are scientific spirit, patriotism, ecological civilization, professional ethics, and

philosophical thinking. In this way, the database now offers a coherent and structured case resource matrix.

(2) Presentation formats have become more diverse.

Multi-modal resources have brought case teaching to life. In order to gauge student perceptions, we conducted surveys. Students liked the video and interactive cases best.

(3) Lesson preparation is more effective

Teachers could find cases more quickly using the tagging system. Time has been decreased by over 40% on average, which is consistent with Sichuan University^[7].

(4) A dynamic updating mechanism is formed

The teaching feedback and case collection systems have been built. We have added five new cases into the case library for this course in this year.

There are still some challenges. The ideological contents of some cases should be mined more deeply and be improved. And the platform is also incomplete, so technical functions of the platform should be completed furtherly, such as intelligent recommendations and better analytics. In addition, the sharing mechanism among schools is still in the exploratory stage, and the promoting scope remained limited. In the future, these problems will be improved based on further research and practice.

5. Conclusion

The case database is a foundation for ideological and political education. We used General Biology as example. This paper has showed how knowledge graphs and multimodal technologies can help us mine, organize, and present ideological content digitally. Based on this, we could build a shared, updatable repository. The practice results showed that this database could solve the common problems in science and engineering courses, such as superficial mining, dull formats, and forced integration. It also could provide rich, targeted materials for case-based teaching.

The national education plan for 2024–2035 calls on us to "accelerate the digital transformation of textbooks." Based on this requirement, we see the digitalization of our case resources as part of this larger effort. In order to better support targeted and individualized teaching, we plan to add more AI-powered features to the database in the future.

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