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On the Gist of Res-Environ Informatics

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Abstract

Resources and environmental issues are inevitable challenges that arise in the development of human civilization. To understand the laws of nature and its interaction with human society through various resources and environmental data, it is essential to employ modern information science and technology, integrate across disciplines, and develop new methods and technologies. This article aims to introduce a new discipline called Res-Environ Informatics and explore several theoretical aspects associated with its formation, including its disciplinary characteristics and objectives. The core objective of Res-Environ Informatics is to address the significant challenges posed by res-environ issues. Its defining feature lies in its focus on humanistic concerns, and it incorporates three key technical features: macroscopicity, applicability, and extensibility. The informational aspect is an inherent attribute of the complex problem of resources and the environment. This article suggests using "res-environ" instead of the common term "resources and environment" to more accurately capture the dialectical and unified connotation of this field. Furthermore, from a perspective of professional development, this paper discusses the driving forces, professional characteristics, goals of professional training, curriculum plans, and teaching resource construction needed for the establishment of a "Res-Environ Informatics" major. We also offer insights into the future development trends of Res-Environ Informatics.

Subject Areas

Higher Education, Resources and Environmental Informatics, Science of New Discipline, Interdisciplinary

Keywords

Res-Environ Informatics, Resoures and Environmental Informatics, New Disciplines, Discipline Construction, Specialty Construction, Interdisciplinary, Sustainable Development, Res-Environ Problems

1. Introduction to Res-Environ Informatics

Human beings have been part of the industrial society for almost five centuries, whereas the emergence of the information society is a relatively recent development, spanning only 70 years. Throughout this progression, issues related to resources and the environment have become progressively more intricate, presenting significant challenges to the symbiotic relationship between humans and the Earth. In order to tackle the diverse challenges encountered in the pursuit of human survival and development, the continuous advancement of science and technology is an unwavering trend [1].

The development of modern science and technology has been characterized by a history of disciplinary differentiation and integration. With the advent of modern information technology, disciplines such as "resources informatics," "environmental informatics," and "Earth information science" have emerged to address the challenges posed by complex data related to resources and the environment [1] [2]. These disciplines focus on specific fields such as resource exploration, environmental protection, and global change, and have developed their own well-established research methods and technical approaches. However, in the face of increasingly complex res-environ issues, it has become evident that solving these challenges effectively requires an interdisciplinary approach rather than relying solely on a single discipline.

In 2021, the journal Science and Shanghai Jiao Tong University jointly announced 125 of the most challenging scientific problems [3]. Upon summarizing and classifying these issues, we found that approximately 10% of the problems pertain to res-environ (resource-environment) challenges concerning human survival and development. These issues include questions such as: Can we stop global climate change? Where do we put all the excess carbon? What happens if all the ice on the planet melts? Could we live in a fossil-fuel-free world? Will the world's population keep growing indefinitely?

To answer these pressing questions, it becomes imperative to not only integrate resource and environmental expertise but also to incorporate multidisciplinary knowledge from areas like economics, ecology, psychology, and Earth science. Additionally, data collection should be conducted using modern information technologies, including remote sensing, IOT (Internet of Things), and AI (Artificial Intelligence). Furthermore, macro-integrative analyses should be undertaken by employing spatio-temporal analysis methods and utilizing tools such as GIS (Geographic Information Systems).

A recent paper published by Chinese scientists partially addresses one of 125 questions: How do migratory animals know where they're going? While this question may appear to fall under the domain of biology, it is actually a matter involving the environment and ecosystems. The study employs a multidisciplinary approach, integrating knowledge from disciplines such as geography, meteorology, molecular biology, geology, atmospheric science, and environmental science. By utilizing techniques like satellite tracking and bioinformatics, the re-

searchers discovered a correlation between global warming and the migration routes of migratory birds. The study concludes that comprehending climate-driven changes in migratory patterns through ecological interactions and evolutionary processes could aid in the conservation of migratory bird populations [4].

One of the top 10 scientific discoveries of 2020, as selected by the journal Nature, was a study that aimed to calculate the number of non-forest trees on Earth [5]. The study suggests that the impact of individual non-forest trees on regional ecosystems is greater than previously anticipated. Another top 10 paper aimed to confirm the validity of the Montreal Protocol by observing atmospheric circulation [6]. Both studies involve macro-resources and environmental analyses that utilize information technologies such as remote sensing and geo-information. Their conclusions provide empirical support for sustainable human development.

These studies illustrate how the scientific methods and ideas utilized have surpassed the boundaries of traditional disciplines, giving rise to a distinct disciplinary character [7].

The integration and differentiation of disciplines serve the purpose of addressing real-world problems. This paper aims to explore a new discipline: res-environ informatics. The practical application of multidisciplinary cross-fertilization has been successfully employed to tackle numerous significant res-environ issues. By incorporating perspectives, theories, and technologies from various disciplines, we can attain a comprehensive understanding and more effectively address the growing complexity of res-environ problems. This interdisciplinary integration effort will offer us more efficient solutions to achieve the goals of sustainable resource utilization and environmental protection.

2. Connotation and Disciplinary Characteristics of Res-Environ Informatics

Res-environ informatics focuses on significant res-environ problems. It goes beyond the traditional problems of environmental pollution or resources depletion that exist in the objective world, as well as purely humanistic theoretical research concerning the development of human society. Instead, it involves integrating diverse resources and environmental data, combining specialized knowledge from various disciplines, and addressing crucial challenges related to the survival and development of human society. Through the entire process of information processing and analysis, res-environ informatics seeks to propose effective solutions and strategies.

2.1. Res-Environ Issues as a Dialectical Unity of Resources and Environment

In Chinese, the term "ZiyuanHuanjing" (resources and environment) carries a nuanced meaning that cannot be simply equated with "resources and environ-

ment" in English. Instead, "ZiyuanHuanjing" should be understood as an integrated concept where resources and environment are dialectically united. "ZiyuanHuanjing" encompasses both "resources" and "environment" and represents a higher-level notion than these individual components. It is similar to terms such as "sci-tech" and "spatio-temporal". Hence, if "resources and environment" or "resources environmental" are used in English as direct translations of "ZiyuanHuanjing," the overall meaning of this concept may not be effectively conveyed. This article proposes the use of "res-environ" to highlight the underlying connotation of dialectical unity between resources and environment.

There is a need to strike a balance between resources utilization and environmental protection. It is necessary to make full use of resources while reducing damage to the environment and to follow the principle of sustainable development in order to ensure the long-term utilization of resources and the continued health of the environment. The naming of disciplines and specialties with "res-environ" is to break the division between resources science and environmental science, establish the idea of dialectical unity of resources and environment, be oriented to solving practical problems, make comprehensive use of res-environ data, and innovatively open up new directions for the development of disciplines and specialties.

2.2. Solving the Major Problems of Res-Environ Requires Informationization Thinking and Modern Information Technology

The integration of information technology and various disciplines has greatly promoted the development of various disciplines and gradually formed new interdisciplinary disciplines, such as bioinformatics, agricultural informatics, economic informatics, and environmental informatics. In the process of solving res-environ problems, researchers have spontaneously combined information technology and knowledge from various disciplines to achieve remarkable results. The re-integration of res-environ science and informatics has formed res-environ informatics.

The utilization of informatization methods is essential in addressing res- environ problems. This entails transforming real-world issues into information models and employing computers to perform intelligent calculations and automated processing at every stage of data acquisition, storage, processing, and outputting. By doing so, we can significantly enhance processing efficiency and effectively tackle major res-environ problems that conventional methods cannot solve.

Taking data acquisition as an example (**Figure 1**), modern information technology combined with traditional methods has greatly improved the efficiency and reliability of information collection.

In reference [8] (China and India lead in greening of the world through land-use management), it is a typical example of the use of the res-environ

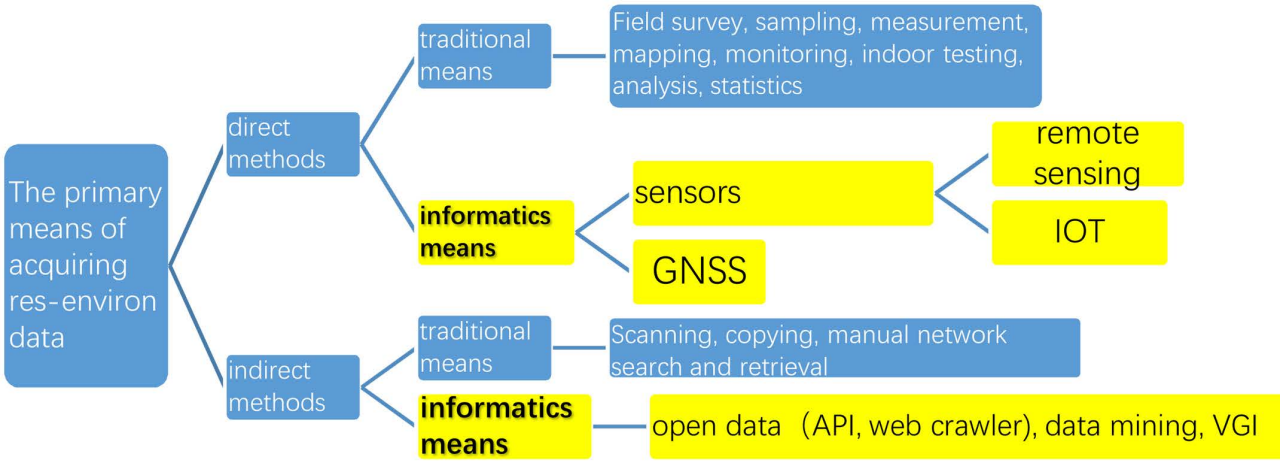

Figure 1. The primary means of acquiring res-environ data. Note: API (Application Program Interface); VGI (Volunteered Geographic Information); GNSS (Global Navigation Satellite System).

informatics approach to explain major res-environ problems.

This study aims to investigate whether the increase in global green space is attributed to direct factors, such as human land use management, or indirect factors, such as climate change. The analysis utilized satellite remote sensing data from the past twenty years, with the leaf area index as the primary indicator. Spatial overlay analysis was conducted to examine actual farmland occupation, and a time series analysis was performed. The research findings reveal that direct factors play a pivotal role in "greening the Earth," accounting for over one-third or even more of the observed net increase in green leaf area. These conclusions challenge the conventional notion that "greening the Earth" is primarily influenced by natural factors.

It can be observed that the efficient and accurate processing and analysis of macro res-environ problems necessitates the application of modern information technology, such as remote sensing, geographic information systems, spatial analysis, time-series analysis, in conjunction with specialized knowledge of resources and the environment, such as the LAI (Leaf Area Index) and LUCC (Land-Use and Land-Cover Change).

2.3. The Disciplinary Core of Res-Environ Informatics

Let's consider one of the "125 big questions" as an illustrative example: What happens if all the ice on the planet melts? Traditional research would typically involve utilizing remote sensing data to acquire glacier DEM data, and then employing 3D GIS and other tools to calculate the potential rise in sea level and the number of cities that may be flooded. However, the objectives and responsibilities of res-environ informatics extend well beyond these conventional approaches.

Res-environ informatics explores the changes that melting glaciers may bring to various aspects of human survival and development. Res-environ informatics studies how much fresh water will be released into the ocean by the disappear-

ance of glaciers, and whether it will disturb the ocean circulation system or even the climate pattern, so as to produce more frequent and serious extreme weather disasters; Res-environ informatics studies the biodiversity disaster in the alpine ecosystems and the polar regions caused by the disappearance of glaciers, as well as the chain reaction to the global ecosystems; Res-environ informatics should study that after the disappearance of glaciers, which are the source of a large number of lakes and rivers, how many regions will face serious water shortage, affecting human life, industrial and agricultural water demand; Res-environ informatics will also study whether glacier melting will release ancient germs and pathogens in the tundra, threatening the biological balance of human society? Furthermore, res-environ informatics needs to study how glacier disappearance occurs? How to prevent glaciers from disappearing? That is another key issue in res-environ informatics: the impact of global warming and climate change on humans.

Although glacier melting poses a significant threat to Earth's survival and humanity, there are still opportunities for humans to address this challenge. Implementing measures such as reducing greenhouse gas emissions, promoting sustainable development, protecting the environment, and adapting to climate change can effectively slow down the rate of glacier melting and mitigate its impact on both human society and ecosystems.

In conclusion, res-environ informatics is an interdisciplinary applied discipline focused on addressing critical issues pertaining to human survival and development. It tackles these challenges by integrating various specialties and adopting a problem-oriented approach.

2.4. The Discipline Boundary of Res-Environ Informatics

According to Yang's theory of disciplinary boundaries, various disciplines are defined by their inner and outer boundaries [9]. Based on different combinations of characteristics, disciplines can be categorized into four types (**Table 1**). As a nascent discipline, Res-Environ Informatics is transitioning from an embryonic stage to maturity and evolving from a loosely defined field to a cross-disciplinary and open discipline.

The boundaries and foundations of established interdisciplinary fields like environmental informatics and resources informatics have become relatively clear

Table 1. Types of disciplines corresponding to different combinations of boundaries.

		Outer Boundaries	
		Clear and stable	Fuzzy and dynamic
Inner boundaries	Clear and stable	Traditional discipline	Interdisciplinary and open
	Fuzzy and dynamic	Rarely existent	Loose

and distinct, leading to the formation of stable scientific communities. A key characteristic of a mature discipline is the clarity of its research focus.

Using freshwater scarcity as an example, in the field of res-environ informatics, our emphasis lies not in categorizing water scarcity as an environmental or resources issue. Instead, we investigate the impact of changing natural conditions on human survival and development, using water scarcity as a basis.

For example, Brottrager [10] studies the impact of natural resource degradation (drought) on population mobility. Yao and Wu' research both analyzes the causes of global water range changes were not only through natural geographical processes, but also closely related to human activities and climate change [11] [12].

It can be seen that the core purpose of res-environ informatics is not to explore resources or the environment itself, but to explore the relationship between changes in res-environ and development of human society.

Therefore, the disciplinary boundaries of res-environ informatics are defined as follows: the internal boundary is clear and stable, positioning it as an applied discipline focused on major res-environ issues. On the other hand, the outer boundary is dynamic and less well-defined, encompassing various macroscopic issues related to resources, the environment, and the Earth system.

In order to establish a clear disciplinary positioning, it is important to distinguish res-environ informatics from related fields based on core features, research objects, major technologies, and methods (**Table 2**).

Table 2. The significant differences between res-environ informatics and several similar disciplines.

	Features	Research Objects	Core Technologies and Methods
Res-environ informatics	Humanistic concern	Major res-environ issues	Interdisciplinary spatio-temporal analysis
Environmental informatics	Focusing on specific environmental problems	Environmental protection, pollution control	Sensing technology, spatial analysis
Resource informatics	Focusing on the utilization of specific industries	Mineral resources, geological survey	Remote sensing, spatial analysis
Earth information science	Emphasizing information acquisition	Earth information	3s (gis, rs, gps), spatial analysis
Earth system science	More focusing on the objective world	Global changes	Remote sensing, climate models
Sustainable development studies	social sciences	Sustainable development	Multi-disciplinary comprehensive analysis

2.5. Disciplinary Characteristics and Basic Principles of Res-Environ Informatics

From the perspective of disciplinary orientation, "res-environ informatics" is a new and rapidly developing interdisciplinary field with a core feature: humanistic concern. Although res-environ informatics is typically classified under Science or Engineering in traditional disciplinary classifications, its most significant aspect is its focus on the well-being and progress of human society. Whether addressing resource-related issues or environmental problems, the ultimate concern of res-environ informatics lies in the development and advancement of human society.

The humanistic nature of the discipline is mainly reflected in the following:

1) Res-environ informatics is not just about objective observation, experimentation and reasoning, but should also take into account human subjectivity, emotions and values. The ultimate goal in selecting research questions, designing experiments, and interpreting results is to derive philosophical inspiration from the laws of knowledge. For example, in Chen's study, the result shows that human activities can have a significant impact on nature [8]. Banerjee examine changes in atmospheric circulation and argues for the effectiveness of anthropogenic macro-environmental policies (emission reduction conventions) [6]. The deeper thought provoked by these studies is that human beings can coexist peacefully with nature and achieve sustainable development.

2) Res-environ informatics is the fusion of natural sciences and humanities. Natural science can provide data and empirical support for the Humanities. At the same time, the philosophy, ethics and cultural research of the humanities can provide reflection and guidance for science, making science pay more attention to human welfare and social sustainable development.

The field of res-environ informatics also possesses three technical characteristics: Macroscopicity, applicability, and expandability.

a) Macroscopicity: The goal of res-environ informatics is to obtain the overall laws of the interaction and development between the Earth and human society. Therefore, the research object is the macro whole of the Earth and human society, rather than focusing on individual objects. This is an important feature that distinguishes it from environmental informatics or resource informatics.

b) Applicability: Res-environ informatics is an application oriented approach that focuses on solving practical problems. The major res-environ issue is the goal, and information technology is the tool. Therefore, res-environ informatics has a significant interdisciplinary nature, which may use a variety of disciplinary expertise without specific disciplinary restrictions.

c) Expandability: The disciplinary boundaries of res-environ informatics increase and expand with the development of information technology and the complexity of res-environ problems. There are two main ways to expand the discipline, one is information technology, such as sensors, Big Data, AI, IOT, cloud computing, AR, VR, blockchain, meta-universe, and the other direction of

expansion is the integration of multiple disciplines. The integration of the latest information technology into practical applications of resources and environments will produce incredible catalytic effects [13]-[18].

Mature disciplines are built upon solid foundational principles, which determine the strength and robustness of the discipline. However, the theoretical system of res-environ informatics is still in its nascent stage. The author identifies two crucial theoretical foundations that warrant special attention for the future development of this discipline: a) How to capture the inherent information attribute of res-environ issues; b) How information flows through natural sciences, social sciences, and humanities, forming an interconnected network.

3. Disciplinary Construction and Specialty Construction of Res-Environ Informatics

Contradiction is the fundamental cause of the development of things [19]. The birth of university is actually due to the contradiction between the growth of knowledge and the transmission of knowledge. The human society should gather intellectuals to preach and impart knowledge (discipline construction) through the organizational structure of university. At the same time, the university should support its own development by serving the society and training talents for the society.

3.1. The Relationship between Disciplinary Construction and Professional Construction

The goal of professional construction is to cultivate talents and serve society, while disciplinary construction is the realization form of knowledge self evolution. A major may be a synthesis of multiple disciplines, and a discipline can also be applied in different professional fields. Discipline construction and professional construction are not contradictory, but interrelated and interactive, leading or lagging behind in development.

At present, the discipline construction of res-environ information science is clearly ahead of professional construction, with significant research advancements being made and gaining mainstream recognition. However, the undergraduate program in Res-Environ Informatics, as defined in this article, has not yet been established.

While there are notable differences in goals and content between professional and disciplinary development (see **Table 3**), there exists a close connection and mutual influence between the two. Professional development relies on the support and guidance of disciplines, while the advancement of disciplines necessitates the contribution and practice of high-quality professionals. Therefore, in higher education, professional development and disciplinary development are crucial aspects that complement and promote one another.

3.2. The Construction Direction of Res-Environ Informatics Major

There are two primary directions for undergraduate major development, which

Table 3. Comparison between professional and disciplinary construction.

	Content	Goals	Executives	Focus
Professional Development	Cultivating students with skills and knowledge necessary for specific professions	Meeting the social demand for specialized professionals	Schools, departments, teachers	Responding to immediate societal needs and making timely adjustments
Disciplinary Development	Academic research, theoretical exploration, and cutting-edge development of disciplines	Advancing the academic research level and promoting disciplinary development	Scholars and researchers in academia	Focusing on academic frontiers and accumulating long-term fruitful results

are focused on disciplinary development and societal needs. The different orientations have a significant impact on the approach to professional development.

For frontier majors at research universities or key majors at regular universities, specialization development can be aligned with disciplinary development. This means cultivating talented individuals who can contribute to the advancement of the discipline. The same principle applies to res-environ informatics. It is crucial to establish exceptional majors at top-tier universities that prioritize disciplinary development. This will enable the cultivation of talented individuals within this discipline, providing valuable experience and future instructors for the professional development of other educational institutions.

For more regular undergraduate institutions, the professional positioning of "Res-Environ Informatics" is a teaching and training system formed by the cross integration of basic knowledge from multiple disciplines based on the job requirements of society. This major is bred in the integration of resources survey, ecological environment monitoring, data mining and other disciplines, and gradually separated from remote sensing, geographic information science, Earth information science and other disciplines, so as to cultivate professional and technical talents for the analysis and processing of res-environ data (see **Figure 2**).

Undergraduate and postgraduate education plays a vital role in training talents for disciplinary development. Currently, most graduate students in the field of res-environ informatics come from majors such as resources and environment, agronomy, remote sensing, and geographic information. However, they need to reconstruct their knowledge structure and thinking approach to conduct more in-depth research in the field of "Res-environ informatics". This situation is not conducive to the discipline's development. Therefore, it is necessary to establish an undergraduate program for res-environ informatics that considers both disciplinary development and social demand.

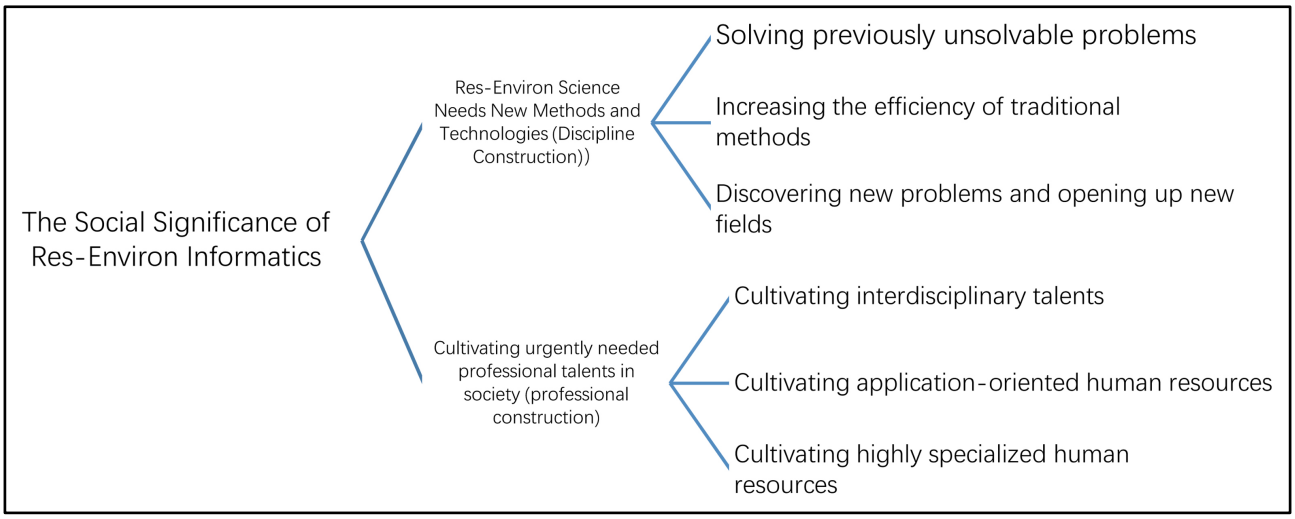

Figure 2. Social significance of res-environ informatics.

In China's general higher education institutions, undergraduate majors are divided into 13 disciplinary categories, including science, engineering, medicine, and agriculture. In 2020, a 14th disciplinary category, cross-disciplinary, was introduced, highlighting the importance of interdisciplinary studies. If a major in res-environ informatics were to be established, we believe it would be appropriate to categorize it under the cross-disciplinary category.

4. Implementation Strategies for the Professional Construction of Res-Environ Informatics

There are many discussions on how to implement the professional construction in the field of higher education. This article analyzes the implementation strategies of Res-Environ Informatics from three aspects: professional training objectives, training plans, and teaching resource construction.

4.1. Professional Training Objectives of Res-Environ Informatics

Clarifying training objectives and formulating training standards is the starting point for implementing professional strategies.

For ordinary public undergraduate applied universities, the professional goals of our concept of "Res-Environ Informatics" are as follows: engineering and technical talents who possess professional knowledge and skills in Res-Environ Informatics and can engage in res-environ data management, analysis, application development, and other related work in enterprises and institutions such as resource and environmental planning and management. Graduates are required to have dialectical thinking of resources and environment, broad vision, informatization thinking ability and innovation awareness, humanistic and scientific literacy, social responsibility and professional ethics. Graduates can become qualified industry engineers in the field of res-environ data analysis after about 2 - 5 years of work practice.

For disciplinary-oriented majors in research universities, the cultivation objectives are as follows: to acquire a solid foundation in the basic theories and methods of res-environ informatics; to develop a comprehensive understanding of related disciplines; to demonstrate proficient use of res-environ information technology; to foster dialectical thinking in the field of res-environ; to cultivate a broad vision; to possess strong information technology thinking abilities; to develop a deep appreciation for humanistic values; to gain profound insights into res-environ issues pertinent to the survival and development of human society; to foster a passion for scientific inquiry; to embrace critical and creative thinking; to diligently engage in practical applications; to nurture a commitment to constant advancement in the realm of science; and to be prepared for further academic pursuits.

4.2. Training Plan for Res-Environ Informatics

Most newly established majors belong to interdisciplinary majors, and the basic idea of training program design is to advance the interdisciplinary integration of disciplines in the graduate stage to the undergraduate stage, and reshape the logical structure of the curriculum. This includes basic and main course design, characteristic course design, logical relationship design between courses, experimental and course internship plans, graduation internships, graduation thesis work, and so on. The more disciplines involved in cross integration, the more complex the structure of new majors, and the more challenging the design of training programs and course construction work becomes.

Compared to mature majors, newly established majors, especially the construction of interdisciplinary majors, face many challenges such as limited experience to learn from, shortage of resources, and insufficient understanding. Therefore, positioning work should be strengthened and valued more. Differentiation construction is a common approach. As shown in the curriculum plan (**Table 4**), emerging technologies in resource and environmental information can focus on one or more aspects such as the Internet of Things, big data, artificial intelligence, cloud computing, and blockchain.

4.3. Teaching Resources Construction

There is a clear difference between the teaching ideas and status of courses with the same name in different specialties. For example, environmental monitoring is an important degree course in major "environmental engineering", with many theoretical and experimental hours, and it is a professional skill for undergraduates. But in the major "res-environ informatics", "environmental monitoring" is as a professional foundation course, the total number of hours and the length of experimental hours will be reduced, and the teaching content has been greatly streamlined and adjusted. Students need to understand what fields environmental monitoring is mainly applied to, what indicators can be monitored and what problems can be solved, and then learn how to use information technology to

Table 4. Curriculum design of res-environ informatics.

Course Category	Course Name
General Education and Foundation Courses	Mathematics (Calculus, Probability Theory, and Linear Algebra), Basic Information Technology, English, Earth Resources and Environment, General Philosophy, History of Science, Historical Geography, Physical Education
Professional Foundation Courses	Introduction to Res-Environ Informatics, Environmental Monitoring, Resource Survey and Evaluation, Computer Programming (R or Python Language), Fundamentals of Statistical Analysis, Res-Environ Economics
Core Professional Courses	Introduction to Earth Systems, Res-environ Remote Sensing, Spatial Analysis, Data Mining, Cutting-Edge Information Technology, Time Series Analysis, Comprehensive Internship, Res-Environ Planning and Management, Sustainable Development

quickly and efficiently obtain res-environ monitoring data, analyze and process the data in their major courses, so as to solve the problems that cannot be solved or are difficult to be solved by traditional methods.

The lack of suitable teaching materials for newly established or incoming majors is a common occurrence. To achieve optimal teaching outcomes, it is not sufficient to merely rearrange and utilize existing teaching materials; instead, it requires a complete curriculum overhaul and the development of new teaching materials and lecture notes. The fundamental concept behind the creation of these new teaching materials and lecture notes is to align them with the cultivation program while closely adhering to the core focus of the specialty. This involves reshaping the theoretical and logical framework of the new field of study, thus laying a strong foundation for the preparation of competent professionals.

Taking the course "Introduction to Res-Environ Informatics" as an example, our proposed teaching syllabus is shown in Table 5. The teaching plan for this course is 32 theoretical hours plus 32 computer experiment hours.

Each training project consists of several tasks, which are completed step by step by the students. All exercises are designed and provided with professional data on res-environ, and students practice them on computers. The purpose of this course is to provide students with a comprehensive understanding of the significance and objectives of their major, as well as the main techniques and methods, and to lay the foundation for further learning in the subsequent courses.

5. Discussion

Emerging disciplines and newly established majors need to clarify the core and underlying logic of the discipline or major, rebuild the logical system, and only a complete logical system can say that the discipline has entered a mature development period. This article is only an introduction and provides some immature

Table 5. Teaching syllabus of the course "Introduction to Res-Environ Informatics".

Table of Contents	Theoretical section	Practical training section
Chapter 1: Res-Environ Informatics	1.1 The inseparable connection between resource development and environmental protection 1.2 Information as the fundamental resource for human social development 1.3 Res-environ information as important basic information for the national economy 1.4 Informatics as a discipline studying how computers can serve humans 1.5 The promising future of res-environ informatics	1.1 Application Fields of Res-Environmental Informatics
Chapter 2: How Res-Environ Objects Enter Computers	2.1 Databases as the primary means of storing and managing data in computers 2.2 Abstraction and modeling as the fundamental approaches for representing the objective world in computers 2.3 How computers express spatial objects 2.4 Global satellite navigation systems as the major means of obtaining spatial positioning information	2.1 Basic Structure of Database (SQLite) 2.2 Database Query Function (SQLiteStudio) 2.3 Database Modeling and E-R Diagram 2.4 Introduction to Network Database 2.5 Raster and Vector Images 2.6 Map projection and map type
Chapter 3: Analytical Tools for Res-Environ Information-Geographic Information Systems	3.1 Geographic Information Systems - computer systems specialized in processing geospatial data 3.2 The core object of GIS processing - digital maps 3.3 The direct purpose of using GIS - creating thematic maps 3.4 The basic functions of GIS - spatial data querying and statistics 3.5 The core function of GIS - spatial data analysis 3.6 Overview of resource and environmental information systems	3.1 Introduction to GIS software 3.2 Use Satellite imagery to calculate the campus area 3.3 Creating the first thematic map 3.4 Overlay of Grid Layers - NDVI Changes 3.5 Creating a thematic map of air quality distribution 3.6 Example of Buffer analysis
Chapter 4: Introduction to Res-Environ Remote Sensing	4.1 Overview of remote sensing 4.2 Theoretical foundations of remote sensing 4.3 Remote sensing platforms and sensors 4.4 Remote sensing image processing 4.5 Remote sensing image interpretation and mapping 4.6 Current status and prospects of resource and environmental remote sensing applications	4.1 Obtaining Remote Sensing Images on Professional Websites 4.2 Remote sensing image preprocessing 4.3 Remote sensing image recognition and classification
Chapter 5: Re-Environ Open Data and Open Source Tools	5.1 Open data and open scientific research 5.2 Internet public data and web scraping 5.3 Obtaining open data using API 5.4 JSON and CSV data formats 5.5 Res-environ open-source tools	5.1 Using web crawlers to obtain open data 5.2 Using API to Obtain Open Data 5.3 Various forms of res-environ open data
Chapter 6: Emerging Technologies Empowering Resource and Environmental Informatics	6.1 Sensors 6.2 Internet of Things (IOT) 6.3 Big data and data mining 6.4 Cloud computing 6.5 Artificial intelligence and deep learning	6.1 Res-environ Sensors and IOT 6.2 New technologies for resource and environmental information 6.3 GEE remote sensing Big data platform

Continued

Chapter 7: Res-Environ Application Models	7.1 Land use/land cover change models 7.2 Vegetation index models 7.3 Evaluation models for res-environ suitability 7.4 Introduction to spatio-temporal analysis models 7.5 Res-environ information tool software	7.1 Mapping of Land Use Change 7.2 NDVI classification mapping of vegetation index 7.3 Assessment of resource Carrying capacity 7.4 Tool software demonstration

reflections on res-environ informatics.

1) Res-Environ Informatics has a long way to go. Res-environ informatics has emerged to address major res-environ issues. It must keep up with the times and face practical issues, such as social changes in the post pandemic era, the impact of ecological environment changes caused by the bombing of the Nord Stream Pipelines, the potential impact of Japan's nuclear sewage discharge on the Earth's and other practical issues. All of these aspects require a comprehensive integration of natural and social interdisciplinary perspectives, considering international political contexts as well, fostering deep cross-fusion.

2) In recent years, there has been a surge in discussions and initiatives concerning the establishment of new disciplines across various domains [7] [20] [21] [22]. This process has given rise to a distinct discipline known as the Science of New Discipline [23], which seeks to uncover the underlying principles governing the creation of such disciplines. Throughout history, China has embraced a tradition of holistic thinking and cultural synthesis, where the unity of "Heaven and Man" and the harmonization of "Yin and Yang" are central concepts. The term "ZiyuanHuanjing" (Res-environ) exemplifies this Oriental cultural essence. Incorporating cultural elements from diverse countries and regions into the development of disciplines and specializations, while integrating the philosophical notion of dialectical unity, represents an innovative endeavor in discipline creation and specialization construction.

3) Technology is a double-edged sword. With the advent of the information society, rapid advancements in information technology have significantly expanded humanity's active role in managing resources and the environment. However, this increased agency also carries the risk of severe backlash. The urgent need for a dedicated discipline that focuses on the dynamic interaction between human beings and the resource-environment system arises. This discipline seeks to explore pathways for harmonious coexistence between humans and the resource-environment system. This, perhaps, is the destiny of Res-Environ Informatics.

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Conflicts of Interest

The authors declare no conflicts of interest.

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