International Journal of Computer Information Systems and Industrial Management Applications
ISSN 2150-7988 Volume 18 (2026) pp. 1-15

https://doi.org/10.70917/ijcisim-2026-0127
Article

Research on the Application of Data Mining Algorithms in the Interdisciplinary Talent Cultivation of Environmental Design Majors in the Context of New Liberal Arts

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Abstract: Based on an analysis of the current state of environmental design education, this article proposes educational objectives for environmental design programs. Drawing on the talent cultivation philosophy advocated by the New Liberal Arts initiative, it establishes strategies for constructing an interdisciplinary teaching system for environmental design programs and designs an interdisciplinary talent cultivation model for the field. To validate the effectiveness of this model, students from the 2023 cohort of an environmental design program at a certain university were selected as research subjects. A semester-long teaching practice was designed to explore the impact of the interdisciplinary talent cultivation model on students' academic performance and interdisciplinary competencies. Additionally, an interdisciplinary teaching quality assessment model for environmental design was constructed using the SLIQ algorithm, laying the foundation for in-depth analysis of data related to interdisciplinary talent cultivation in environmental design. The results showed that the final exam scores of the experimental class (HJ1) reached 86.61 points, an increase of 19.45% compared to the pre-test scores. In contrast, the final exam scores of the control class (HJ2) only increased by 1.29 points compared to the pre-test scores, and there was a significant difference between the two classes ($p<0.01$). The interdisciplinary literacy of students in the experimental class increased by 13.20% compared to before the experiment, and there was a significant difference between the teaching practices before and after the experiment ($p<0.01$). Therefore, the interdisciplinary talent cultivation model helps enhance the knowledge mastery level of environmental design students and also helps them improve their interdisciplinary literacy level.

Keywords: SLIQ algorithm; environmental design major; interdisciplinary talent cultivation; teaching quality assessment

1. Introduction

With the rapid development of society, the demand for professional technical talent in environmental design has been growing rapidly, leading to a severe shortage of such professionals [1]. Therefore, in the context of the marketization of higher education, many comprehensive local universities have established environmental design programs [2]. Environmental design is an emerging field of professional education, and its primary teaching methods and educational systems are not yet fully developed. Currently, the demand for environmental design talent in the social market and enterprises primarily focuses on mid-to-high-level practical design talent and high-end specialized talent [3-4], rather than purely theoretical scholars. This characteristic should attract the attention of China's higher education community, necessitating the urgent exploration of an educational path suited to China's societal development needs.

Regarding the current environmental design programs in higher education institutions, their curricula and course structures largely follow the educational models of undergraduate education, with educational frameworks still based on the teaching plans of associate and bachelor's degree programs. This approach places insufficient emphasis on cultivating students' professional competencies, overemphasizes academic performance, and neglects the development of students' environmental design capabilities [5-7]. Such a teaching model is merely aimed at fulfilling educational plans and tasks, which is detrimental to the cultivation and selection of professional talent with potential in environmental design [8]. As an interdisciplinary and comprehensive field integrating engineering technology, humanities, art design, and architecture, environmental design encompasses multiple disciplines such as landscape art, fine arts, architectural design fundamentals, ergonomics, materials science, and social psychology [9-11]. In this interdisciplinary context, different institutions have exhibited uncertainty and ambiguity in defining the scope of environmental art design programs [12]. Literature [13] proposes a teaching method suitable for interdisciplinary research and collaboration in the field of environmental design education, filling the gap in current environmental design education practices. Literature [14] addresses the issue of interdisciplinary talent cultivation in environmental design and proposes a new environmental design philosophy that emphasizes the use of comprehensive, human-centered, and interdisciplinary methods to construct sustainable living/spatial ecosystems. Literature [15] addresses the interdisciplinary nature of environmental design students, focusing on sustainability literacy and interdisciplinary integration through a project on river ecological restoration, which yielded positive outcomes for students and provided educators with profound insights. Literature [16] applies interdisciplinary theory to explore its application in environmental design education curricula, emphasizing the benefits of such curricula for students and the importance of stakeholder participation. Literature [17] explores and evaluates the effectiveness of interdisciplinary teaching methods in environmental design education, finding that the focus lies in cultivating practical and innovative multidisciplinary talent to enhance students' learning outcomes and employment competitiveness.

The environmental design market is currently experiencing unprecedented growth, with an increasing demand for environmental design talent. At the same time, the market has set new requirements for the practical skills of environmental design professionals. This article examines the current state and future goals of environmental design talent cultivation, and based on the new liberal arts talent cultivation philosophy, it constructs an interdisciplinary teaching system and an integrated talent cultivation model. Taking the 2023 cohort of environmental design students at a university in Province T as an example, a teaching practice experiment was designed to analyze the effectiveness of the interdisciplinary talent cultivation model. Additionally, the teaching quality of interdisciplinary talent cultivation in environmental design is evaluated using the SLIQ algorithm, with the introduction of the optimal split point and DML pruning algorithms to enhance the precision of data mining in environmental design education.

2. Interdisciplinary Talent Cultivation Model for Environmental Design Majors

The environmental design major plays an important role in higher education in cultivating high-quality talent with creative design, spatial planning, and environmental management capabilities. However, there are currently many issues with the cultivation of talent in this major. Universities need to carry out systematic reforms in areas such as the curriculum system, practical teaching, faculty teams, and cultivation objectives in order to improve the quality of talent cultivation in the environmental design major and meet the needs of society and the market.

2.1. Training of Environmental Design Professionals

2.1.1 Current Status of Professional Development in Environmental Design

The introduction of China's art and design education system can be traced back to the 1980s. After years of development, China's art and design education has made significant progress. Currently, in Chinese universities, in addition to specialized art and design institutions, environmental design programs are now offered not only by science and engineering universities but also by teacher training universities and even agricultural and forestry universities. With the vigorous development of environmental design education, China has become a major exporter of environmental design professionals. This achievement is attributable to the government's emphasis and support, the active cooperation of society, and the dedicated efforts of educational institutions. Environmental design education in higher education is currently in a phase of robust growth.

However, due to the late start of environmental design education in China, coupled with some schools rushing to expand their enrollment and social influence, environmental design programs were hastily established without adequate educational resources. This has led to issues such as traditional and conservative teaching concepts, inadequate teaching facilities, and weak faculty strength, which have become major obstacles to talent cultivation. This has resulted in a significant gap between the design talent produced by universities and the requirements of employers, leading to a mismatch between the output of environmental design talent from universities and the demands of environmental design enterprises in society. In the face of such a severe issue, we should conduct research and analysis on the problems encountered in university environmental design programs and seek solutions to address them, in order to better develop China's environmental design education and enhance the quality of talent cultivation in university environmental design programs.

2.1.2. Environmental Design Talent Training Goals

Environmental design is an interdisciplinary field that encompasses knowledge and skills from multiple disciplines. Environmental designers must possess knowledge of the humanities and social sciences, such as human behavior, psychology, and sociology, to understand people's spatial needs and behavioral habits, thereby better meeting user requirements. Additionally, artistic knowledge is essential for environmental designers, including color theory, form theory, and art history, to create aesthetically pleasing, comfortable, and creative environments. In terms of professional skills, environmental designers must have a solid foundation in fine arts, as well as proficiency in professional drafting and visualization techniques. They must also be skilled in using computer software to assist in presenting and interpreting design concepts.

Under the new liberal arts framework, enhancing the comprehensive qualities of environmental design professionals requires strengthening awareness of new technology applications, as well as progressing from understanding to application, and from application to innovation, to achieve the transformation of environmental design talent cultivation outcomes [18]. Figure 1 illustrates the talent cultivation objectives for environmental design, emphasizing the development of digital skills. By integrating digital technology advancements with professional development and leveraging accumulated digital technology expertise, the goal is to cultivate environmentally design professionals with digital proficiency.

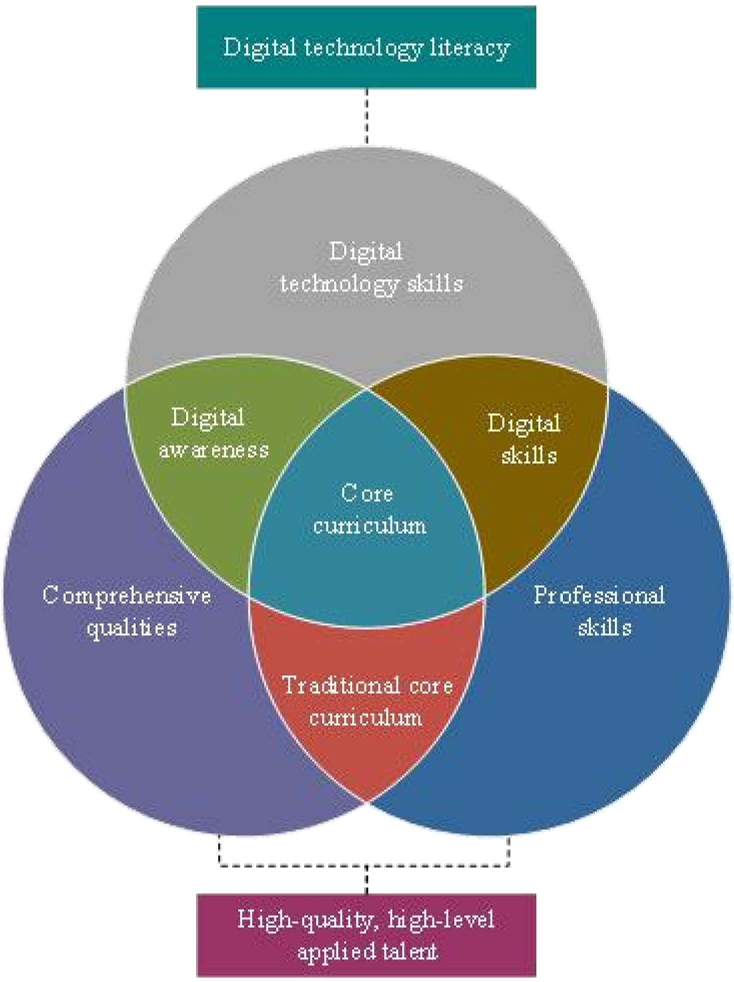

Figure 1. The training objective for environmental design talents.

2.2. Interdisciplinary Talent Cultivation Model

2.2.1. Talent Cultivation Philosophy of the New Liberal Arts

Under the advocacy of new liberal arts education, environmental design programs should emphasize interdisciplinary integration, cultivating students' artistic literacy in areas such as drawing, aesthetics, and form, while also teaching engineering knowledge such as construction techniques and materials science, and strengthening the cultivation of computer-aided design skills. Interaction with related majors such as visual communication design and digital media design should be enhanced to form a cross-disciplinary knowledge system [19].

Under the new liberal arts philosophy, traditional liberal arts programs must be reformed, and disciplinary development must adapt to industrial transformations to achieve deep interdisciplinary integration. Additionally, the development of artificial intelligence and virtual reality technology has brought new opportunities to the Environmental Design program, with art and technology converging in diverse ways, thereby imposing new demands on the cultivation of interdisciplinary talent in Environmental Design. Based on this, efforts must be accelerated to advance program development, disciplinary construction, and curriculum reform, while innovating the talent cultivation model for the Environmental Design program. This involves restructuring and integrating professional course systems and disciplinary knowledge, updating teaching content and methods, breaking down disciplinary boundaries, and promoting the coordinated development of other design disciplines such as visual communication design, product design, and digital media art. With artistic creation as the foundation, technological innovation as the driving force, and industrial demand as the orientation, this approach aims to cultivate composite talent with both artistic and professional literacy.

2.2.2. Establishing an Interdisciplinary Teaching System

Environmental design is an interdisciplinary field that integrates various disciplines, including art, architecture, engineering, environmental science, and sociology. Therefore, establishing an interdisciplinary teaching system is a key strategy for enhancing the quality of environmental design education. This is primarily manifested in the following aspects:

(1) Curriculum reform. The curriculum should comprehensively cover all fields related to environmental design, such as art, architecture, engineering technology, and environmental science, while emphasizing the connections and integration among these disciplines.

(2) Interdisciplinary projects. Conduct interdisciplinary design projects to allow students to experience the integration and complementarity of knowledge across disciplines in practice, thereby enhancing their ability to solve problems comprehensively.

(4) Collaborative teaching. Collaborate with faculty from other disciplines in teaching, such as having instructors from different disciplines co-teach a course or jointly supervise a design project.

(5) Enhancing students' interdisciplinary learning abilities. Provide interdisciplinary learning resources and platforms to encourage students to engage in self-directed learning, thereby improving their interdisciplinary learning and research capabilities.

The implementation of these strategies not only reinforces the interdisciplinary nature of environmental design education but also enhances students' overall qualities and innovative awareness, enabling them to seamlessly transition into professional roles upon graduation.

2.2.3. Interdisciplinary Talent Cultivation Model

This paper addresses the issues currently existing in the cultivation of environmental design professionals. Guided by the national innovation-driven development strategy and the new engineering discipline philosophy, it aligns with the demands of the new economy and emerging industries. Considering the educational level and characteristics of general universities, the goal is to cultivate high-quality, composite innovative talents capable of addressing societal development and industrial production challenges. Taking interdisciplinary integration as the entry point, an environmental design professional cultivation model is designed and constructed, as shown in Figure 2. Under this model, inter-departmental, inter-institutional, and industry-academia collaboration can be achieved, with seamless integration between the first and second classrooms across multiple modules and stages. This collaborative approach promotes interdisciplinary integration, industry-academia-research collaboration, and innovative education. The aim is to effectively enhance students' application and innovation capabilities, enabling them to quickly adapt to the demands of the job market [20].

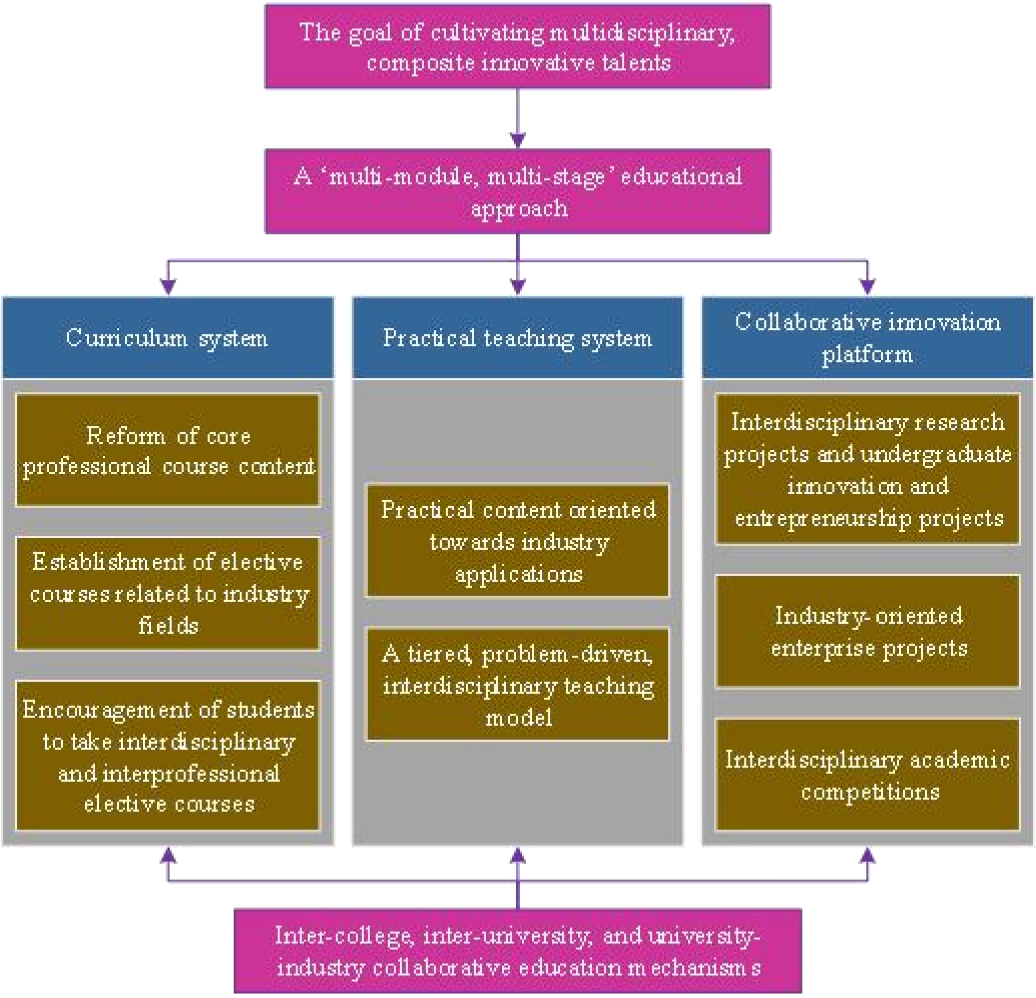

Figure 2. Interdisciplinary cross fusion talent culture model.

The Environmental Design program requires the establishment of a high-quality faculty team with strong academic backgrounds and industry experience to effectively undertake the task of cultivating interdisciplinary talent. By collaborating with other disciplines and industries, a faculty team with interdisciplinary backgrounds can be formed to jointly conduct research and teaching activities, integrating knowledge and methodologies from different disciplines to enhance the overall quality of faculty members. In collaboration with industries and enterprises, the program can advance talent cultivation in environmental design. Industries and enterprises provide data resources, practical projects, and practical opportunities, while universities contribute student resources and technical expertise. Through multi-party cooperation among departments, universities, and industry-academia partnerships, resource sharing and complementary advantages can be achieved.

3. Teaching Experiment Design for Interdisciplinary Talent Cultivation Model

University environmental design programs need to adapt to societal developments and establish talent cultivation models suited to their own growth. University environmental design programs should leverage the unique characteristics of their institutions, clarify their professional talent cultivation objectives, and develop distinctive talent cultivation plans tailored to environmental design. Through competition mechanisms, students can gain a deeper understanding of the discipline and industry trends. A diversified evaluation system aligned with the discipline's characteristics should be established, and a research-industry-education development consortium should be formed. This will enable the creation of a talent cultivation model for environmental design that highlights the distinctive features and disciplinary advantages of the field.

3.1. Research Subjects and Survey Questionnaire

3.1.1. Selection of Research Subjects

The research subjects of this study were 84 students majoring in environmental design at a university in Province T in the class of 2023, including 39 female students and 45 male students. The research subjects were approximately 20 to 22 years old and were in the intensive learning phase of their environmental design studies, a transitional period from concrete, intuitive thinking to abstract, logical thinking. Their educational activities still relied on concrete objects and experiences. Through interactions with the students, we found that most of them expressed a strong interest in interdisciplinary integrated teaching models. Considering the characteristics of the students' developmental stage, this study selected the “Commercial Space Design” course for teaching within the environmental design program. By leveraging an interdisciplinary integrated talent cultivation model, students can access a broader range of knowledge, making the application of professional knowledge more intuitive. Students demonstrated a high level of interest in such interdisciplinary learning.

This study used a random number table method to randomly divide 84 students into two identical groups: the experimental class (HJ1) and the control class (HJ2), with 42 students in each class. In the subsequent teaching experiment, the interdisciplinary integration talent cultivation model designed earlier was implemented in the experimental class to conduct the “Commercial Space Design” course. The control class, however, adopted the traditional teaching model without incorporating interdisciplinary knowledge integration.

The teaching experiment was conducted from September 2024 to January 2025. Before and after the implementation of the teaching experiment, the students' performance in the “Commercial Space Design” course was tested to validate the effectiveness of the interdisciplinary integration talent cultivation model.

3.1.2. Questionnaire Design

To effectively assess the application effectiveness of the interdisciplinary integration talent cultivation model designed in this paper within environmental design professional courses, two types of survey questionnaires were designed: one targeting students' interdisciplinary awareness and the other targeting teachers' influencing factors. These aim to provide reliable data support for talent cultivation in environmental design.

(1) Interdisciplinary Awareness Competency Scale for Students

To assess students' interdisciplinary awareness and literacy, this study drew upon existing relevant research literature to summarize an interdisciplinary awareness framework tailored for environmental design students. This framework comprises five dimensions: interdisciplinary knowledge level, interdisciplinary thinking ability, interdisciplinary inquiry ability, interdisciplinary collaboration ability, and interdisciplinary attitude. This framework provides a basis for understanding changes in students' interdisciplinary awareness and literacy under the interdisciplinary talent cultivation model.

(2) Teacher Comprehensive Influence Scale

In the implementation of an interdisciplinary talent cultivation model, teachers, as the primary responsible parties for teaching, have a significant influence on students' interdisciplinary awareness. Therefore, this paper further designed a survey questionnaire to analyze the impact of teachers on the quality of students' interdisciplinary literacy cultivation. Teachers' comprehensive influence is primarily composed of seven dimensions: professional knowledge, academic interest, research ability, scholarly attitude, moral cultivation, academic norms, and others. This aims to explore the extent of teachers' influence on students in environmental design classroom settings.

To facilitate data analysis, all survey questions in this study were designed using a five-point Likert scale. In the interdisciplinary literacy scale for students, the options 1–5 represent “strongly disagree,” “disagree,” “neutral,” “agree,” and “strongly agree,” respectively. In the comprehensive influence scale for teachers, the options 1–5 represent “very small,” “somewhat small,” “neutral,” “somewhat large,” and “very large,” respectively.

3.2. Interdisciplinary Talent Cultivation Teaching Experiment

3.2.1. Interdisciplinary Teaching Process Design

This study draws on existing interdisciplinary project design models and currently mainstream educational application models, combined with the preceding analysis of talent cultivation in university environmental design programs, to establish an interdisciplinary talent cultivation teaching process tailored to contemporary university environmental design programs. The specific process is illustrated in Figure 3.

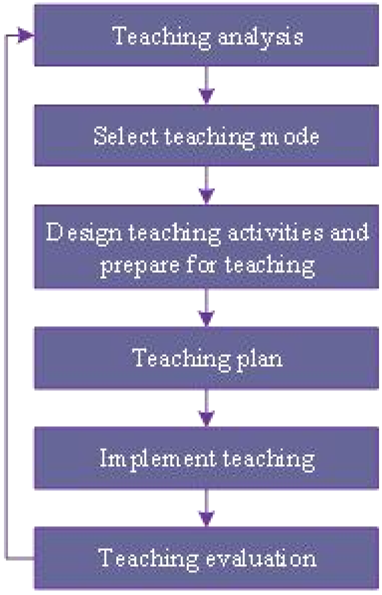

Figure 3. Teaching process for interdisciplinary talent cultivation.

As shown in the figure, when designing interdisciplinary talent cultivation teaching for environmental design majors, the teaching steps are as follows:

Step 1: Conduct teaching analysis from three aspects: interdisciplinary knowledge, learner characteristics, and teaching objectives.

Step 2: Select a teaching model suitable for this lesson based on the results of the teaching analysis.

Step 3: Design teaching activities and prepare for teaching.

Step 4: Teaching activities are designed from two aspects: learning activities and group collaboration.

Step 5: Implement the classroom teaching of "Commercial Space Design."

Step 6: Teaching evaluation includes formative evaluation and summative evaluation. Based on the results of the teaching evaluation, the teaching design is supplemented and modified.

3.2.2. Implementation Process of Interdisciplinary Teaching

This paper takes the course "Commercial Space Design" as an example to specifically analyze the application of interdisciplinary talent cultivation models in course teaching, utilizing a new teaching model that covers the entire teaching process.

(1) Before the course begins. Teachers can use network technology to upload classroom teaching videos, teaching materials, and other resources to teaching platforms or learning groups. Based on course requirements, they can develop different modules to facilitate student learning. For example, when learning spatial design theory, instructors can divide the theoretical knowledge into different modules with varying content and durations, allowing students to accumulate knowledge through cumulative learning. As the course progresses, students can engage in on-site simulated learning, enabling them to independently select and apply concepts in practice. This approach allows students to gain a preliminary understanding of design knowledge through pre-class foundational learning, which can be further refined in subsequent learning phases.

(2) In classroom teaching. In class, teachers can address common issues faced by students through focused explanations and encourage students to share their learning experiences. For example, in environmental design and perspective learning, students may have already gained an understanding of the characteristics of commercial space design before class, but they may struggle to integrate spatial design with practical application. Teachers can address learning challenges by providing comprehensive guidance, facilitating student discussions, and fostering a positive learning environment. Additionally, teachers can utilize databases to help students acquire relevant knowledge, enabling them to apply it in spatial design and alleviate anxiety.

(3) After course completion. After the course, teachers can assign homework on the learning platform and customize assignments based on students' individual characteristics. Students may encounter various issues during the environmental design process, such as inadequate understanding of perspective or problems with drafting. In response to these challenges, teachers can provide interdisciplinary resources to help students grasp cutting-edge disciplinary knowledge. By aligning this with the latest trends in

environmental design and understanding industry demands for talent, students can further integrate interdisciplinary knowledge in their teaching practice based on their interests.

3.3. Interdisciplinary Teaching Quality Assessment Model

3.3.1. SLIQ Algorithm and Its Attribute Selection

The SLIQ algorithm employs pre-sorting technology and introduces two new data structures—attribute tables and class histograms—to facilitate the rapid and accurate identification of optimal split points for each attribute. The SLIQ classifier uses the Gini coefficient of binary splits as the criterion for selecting attribute splits. To analyze the interdisciplinary talent cultivation model in environmental design, this paper applies the SLIQ algorithm to mine its teaching data, thereby better achieving interdisciplinary teaching quality assessment. Assuming a dataset D has m distinct classes $C_i(i=1,2,\cdots,m)$, i.e., the class label attribute has m distinct values, the Gini coefficient is defined as:

$$Gini(D)=1-\sum_{i=1}^{m}p_i^2 \tag{1}$$

Among them, the value p_i is the non-zero probability that any tuple in D belongs to a certain class C_i, that is:

$$p_i=\frac{\text{The number of Class } C_i \text{ tuples}}{\text{The total number of tuples in } D} \tag{2}$$

If the dataset D is divided into two subsets, D1 and D2, based on attribute A, then we obtain:

$$Gini_A(D)=\frac{|D_1|}{|D|}Gini(D_1)+\frac{|D_2|}{|D|}Gini(D_2) \tag{3}$$

According to Shannon's information theory, information entropy is a scalar measure of the degree of disorder in an information system. The higher the entropy, the more disordered the information system; the lower the entropy, the more orderly the information system. In data mining, classification involves categorizing records in a dataset according to rules and in an organized manner. Therefore, the optimal splitting attribute selected is the one that reduces information entropy by the greatest amount, thereby maximizing the reduction in the system's degree of disorder.

3.3.2. Optimal Split Point and DML Pruning Algorithm

When selecting split attributes and split points, the algorithm calculates the information gain brought about by each possible split and selects the split point with the largest information gain as the optimal split point. The formula for calculating information gain $IG(D,A)$ is:

$$IG(D,A)=H(D)-\sum_{v\in Values(A)}\frac{|D_v|}{|D|}H(D_v) \tag{4}$$

Among them, A is the candidate splitting attribute, $Values(A)$ is all possible values of attribute A, D_v is the subset when the value of attribute A is v, $|D|$ is the size of dataset D, and $|D_v|$ is the size of dataset D_v.

The algorithm designed in this paper uses decision tree pruning technology to improve the generalization ability of the decision tree by minimizing its complexity, thereby avoiding overfitting. The DML pruning algorithm is based on an information-theoretic principle, namely, that the best model for a given dataset is the one that can describe the data with the shortest description length (i.e., the smallest amount of information). The DML pruning process can be represented as a multi-objective optimization problem, whose optimization objective is to minimize the cost. That is:

$$\mathrm{Cos}\,t(T)=-\log L(T\mid D)+\frac{1}{2}k\log N \tag{5}$$

In this context, T denotes a decision tree model, $L(T\mid D)$ is the likelihood function of model T given dataset D, k is the number of parameters in the model (typically corresponding to the number of leaf nodes in the decision tree), and N is the number of samples in dataset D. $-\log L(T \mid D)$ is the negative log-likelihood of model T for the given dataset D, and $\frac{1}{2} k \log N$ is the penalty term for model complexity, measured by the size of the tree.

In the quality assessment of interdisciplinary talent cultivation in university environmental design programs, the application of the DML pruning algorithm ensures that the decision tree model maintains sufficient fit while avoiding over-complexity that could compromise its predictive ability on unknown data. By pruning the decision tree, the system can eliminate attributes that contribute little to the quality assessment, thereby simplifying the assessment model and improving its efficiency and accuracy. This process is crucial for identifying and reinforcing the key factors influencing the quality of interdisciplinary teaching in university environmental design programs, helping educational administrators and teachers develop more scientific and effective teaching improvement strategies based on data-driven insights.

4. Analysis of the Teaching Effectiveness of Interdisciplinary Talent Cultivation Models

The development of the environmental design major has undergone three distinct phases, evolving from the early "environmental art design" to "art design" and finally to "environmental design." This tortuous developmental process has allowed the essence of environmental design to return to its roots, making the professional direction and scope of environmental design more scientifically grounded. This is the result of the inherent development of environmental design itself, reflecting the era's demand for innovative and personalized talent, while also presenting new challenges for the cultivation of environmental design professionals.

4.1. Analysis of Environmental Design Student Performance

4.1.1. Comparison of Students' Pre-Test and Post-Test Scores

To avoid the influence of other factors on teaching effectiveness, a pre-test analysis was conducted using SPSS software on the previous semester's exam scores of the experimental class and the control class prior to the interdisciplinary talent cultivation model teaching experiment for environmental design students. The specific results are shown in Table 1. As shown in the table, prior to the start of the teaching experiment, the final exam scores for the experimental class (HJ1) and the control class (HJ2) were 72.51 points and 71.89 points, respectively, with a difference of only 0.62 points, indicating that the average scores of the two classes were relatively close. Additionally, the results of the t-test for mean equality showed that t = 0.371 and the Sig. (two-tailed) value was 0.753 > 0.05. This indicates that there was no statistically significant difference in the pre-test scores of the two classes before the teaching experiment began, so they could be selected as the research subjects.

Table 1. The results of the students' pre-test results.

Class	No.	Means	STD	Std.Er
HJ1	42	72.51	10.951	1.525
HJ2	42	71.89	11.793	1.746
t	Sig. (2-tailed)	Mean difference	The difference is 95% CI	
			Lower	Upper
0.371	0.753	0.62	-3.876	5.451

After a semester of teaching practice, an examination was conducted for the "Retail Space Design" course for students in two classes. The examination scores from both classes were entered into SPSS software for analysis, with the results shown in Table 2. Based on the data in the table, it can be seen that after implementing the interdisciplinary talent cultivation model in the teaching of environmental design courses, the experimental class (HJ1) achieved a final score of 86.61, representing an increase of 19.45% compared to the pre-test scores. In contrast, the control class (HJ2) saw only a 1.29-point increase in final scores compared to the pre-test, with the overall improvement being less significant than that of the experimental class. Additionally, in the results of the t-test for mean equality, t = 0.3289 and the Sig. (two-tailed) value was 0.005 < 0.01. Therefore, it is concluded that there is a highly significant difference at the 1% level between the post-test scores of the experimental class and the control class. This indicates that the application of the interdisciplinary talent cultivation model in environmental design professional course instruction can enhance students' mastery of environmental design professional knowledge and improve their academic performance.

Table 2. The results of the students' post-test results.

Class	No.	Means	STD	Std.Er
HJ1	42	86.61	6.237	1.329
HJ2	42	73.18	10.681	1.654
t	Sig. (2-tailed)	Mean difference	The difference is 95% CI	
			Lower	Upper
3.289	0.005	13.43	0.479	4.382

4.1.2. Comparison of Individual Subject Scores and Overall Scores

To further illustrate the effectiveness of the interdisciplinary integration talent cultivation model, this paper categorizes the examination papers for the Environmental Design major into two types: single-subject knowledge and comprehensive analysis. Single-subject knowledge primarily covers theoretical concepts related to “Retail Space Design,” while comprehensive analysis questions integrate knowledge from other disciplines to assess students' ability to apply interdisciplinary knowledge. The ratio of single-subject knowledge to comprehensive analysis questions is 7:3. The scoring results for different question types before and after the teaching experiment are shown in Tables 3 and 4.

Based on the data in the tables, prior to the teaching experiment, the score differences between the experimental class and the control class in single-subject knowledge and comprehensive analysis were 0.44 points and 0.18 points, respectively. The P-values from the independent samples t-test were 0.239 and 0.581, respectively, both greater than 0.05. This indicates that before the teaching experiment began, students in both classes had similar levels of mastery of single-subject knowledge and comprehensive analysis. After the teaching experiment, the score differences between the experimental class and the control class in subject-specific knowledge and comprehensive analysis were 9.40 points and 4.03 points, respectively, and the P-values were both less than 0.01. This indicates that the interdisciplinary integration talent cultivation model can significantly enhance students' subject-specific knowledge and interdisciplinary comprehensive knowledge, thereby enhancing their comprehensive abilities and laying the foundation for achieving interdisciplinary talent cultivation outcomes in the field of environmental design.

Table 3. The scoring situations of different types of questions before test

Type	Class	Means	STD	*t*	*p*
Simple knowledge	HJ1	50.76	4.817	-0.296	0.239
	HJ2	50.32	3.595		
Comprehensive analysis	HJ1	21.75	1.143	-0.373	0.581
	HJ2	21.57	0.832		

Table 4. The scoring situations of different types of questions after test

Type	Class	Means	STD	*t*	*p*
Simple knowledge	HJ1	60.63	2.891	-3.795	0.009
	HJ2	51.23	2.364		
Comprehensive analysis	HJ1	25.98	1.508	-0.592	0.275
	HJ2	21.95	1.373		

4.1.3. Comparison of Learning Outcomes and Innovation

To examine the impact of an interdisciplinary talent cultivation model on the learning outcomes and innovative capabilities of environmental design students, this study conducted pre- and post-test questionnaire surveys on the experimental group and the control group, covering three scales: learning motivation, innovative tendencies, and professional satisfaction. Using two classes as examples, a total of 84 valid questionnaires were collected. At the pre-test stage, there were no significant differences in the mean scores of the two groups across the three indicators ($P > 0.05$), indicating that their initial levels were comparable. After a semester of instructional intervention, a post-test was conducted, yielding the following comparison results for learning outcomes and innovative capacity between the two classes, as shown in Table 5.

In terms of learning motivation, the experimental class's score increased from 3.41 ± 0.43 before the experiment to 4.18 ± 0.35 after the experiment, while the control group's score increased from 3.42 ± 0.41 to 3.58 ± 0.45. Although both classes saw improvements, the experimental class showed a greater increase. Based on the t-test results, the post-test mean score of the experimental class was significantly higher than that of the control class ($t = 3.276$, $p = 0.002 < 0.01$).

In terms of innovative tendencies, the experimental group's scores increased by 0.61 points before and after the experiment, while the control group's scores only increased by 0.22 points. Based on the t-test results, the comparison between the two groups also showed a significant difference (t=2.953, p=0.005<0.01), indicating that the experimental group's students showed more significant improvements in creative thinking divergence and acceptance of new technologies.

In terms of professional satisfaction, the experimental group increased from 3.24 (±0.53) points to 4.06 (±0.42) points, while the control group only increased from 3.25 (±0.51) points to 3.48 (±0.42) points, showing an extremely significant difference at the 1% level (t=3.052, P=0.001<0.01). This indicates that the interdisciplinary integration talent cultivation model supports environmental design professional teaching reforms that effectively stimulate students' interest and confidence in professional courses.

In summary, the mean scores in the post-test of the experimental class were significantly higher than those of the control group, confirming that the interdisciplinary integration talent cultivation model has a positive impact on students' thinking and learning attitudes.

Table 5. Comparison of learning outcomes and innovation.

Index	Test	HJ1	HJ2	*t*	*P*
Learning motivation	Before	3.41±0.43	3.42±0.41	0.531	0.335
	After	4.18±0.35	3.58±0.45	3.276	0.002
Innovation tendency	Before	3.28±0.51	3.29±0.46	0.268	0.294
	After	3.89±0.49	3.51±0.43	2.953	0.005
Professional satisfaction	Before	3.24±0.53	3.25±0.51	0.194	0.329
	After	4.06±0.42	3.48±0.42	3.052	0.001

4.2. Effectiveness of Environmental Design Talent Cultivation

4.2.1. Analysis of Teachers' Comprehensive Influence

After implementing an interdisciplinary talent cultivation model for the environmental design program, a survey and analysis were conducted to assess the comprehensive influence of faculty members. Prior to data analysis, the reliability and validity of the faculty comprehensive influence scale were first tested. The results showed that the overall Cronbach's α coefficient was 0.942 > 0.85, indicating that the overall reliability of the survey results was very high, effectively minimizing inconsistencies between sample and population results caused by random errors. Additionally, the reliability of variables within each sub-research category was above 0.65, all within acceptable ranges. The strong correlations among variables demonstrate that the consistency and reliability of the questionnaire designed for this study are robust, i.e., the reliability is high. The KMO measure is 0.841, which, according to standards set in relevant literature, indicates good correlations among variables, making it suitable for factor analysis. Additionally, Bartlett's significance level is 0.005, meaning that the construct validity of this study's questionnaire is good and suitable for statistical analysis.

In principle, teachers are not only the "guides" for students' scientific research training but also bear the obligation and responsibility of guiding students on how to be a person and how to act. That is, teachers should not only focus on cultivating students' professional knowledge and skills but also pay attention to the education of students' comprehensive qualities. Therefore, this study comprehensively evaluates the influence of teachers on the quality of student cultivation through seven dimensions. Based on the survey questionnaire data, the specific structure is shown in Table 6.

A comprehensive comparison of the statistical results shows that teachers have a significant influence on students in terms of academic attitude, moral cultivation, and academic norms, with the mean scores for these three dimensions all around 4.18. Teachers have the greatest influence on students' academic interests, with a score of 4.37, and also have a significant influence on students' professional knowledge. However, teachers' role in enhancing students' research capabilities is generally limited. The data from this study indirectly supports the following two conclusions: first, the research confirms that teachers bear the dual responsibilities of "teaching" and "educating," and at least students perceive that teachers have a significant influence on their moral character. Therefore, teachers should place greater emphasis on positively guiding students' overall development and avoid the negative phenomenon previously highlighted by scholars where some teachers "teach but do not educate." Second, the data above indicates that teachers have limited influence on students' overall research capabilities. Generally speaking, education is about enhancing students' comprehensive qualities and reinforcing their foundational subject knowledge. Teachers should focus on cultivating and further enhancing students' academic interests, fully guiding them to engage with and track cutting-edge academic knowledge, continuously supplementing and reinforcing their comprehensive theoretical knowledge, and promoting the comprehensive enhancement of their interdisciplinary comprehensive qualities.

Table 6. The influence of teachers on the quality of students' cultivation.

Factor	Option Distribution percentage (%)					Means	Variance
	1	2	3	4	5		
Professional knowledge	2.51	10.08	18.35	29.41	39.65	3.91	1.283
Academic interest	4.06	5.43	25.46	35.78	29.27	4.37	1.105
Scientific research ability	2.73	4.16	22.37	33.15	37.59	3.95	1.043
Academic attitude	2.69	4.28	15.62	30.47	46.94	4.21	1.016
Moral cultivation	2.51	5.47	20.25	22.19	49.58	4.15	1.137
Academic norms	1.38	6.38	17.38	30.28	44.58	4.18	1.024
Other	5.46	4.02	15.76	24.72	50.04	3.84	1.206

4.2.2. Survey on Students' Interdisciplinary Literacy

Reliability analysis was conducted to assess the reliability of the questionnaire. The data from the interdisciplinary literacy survey questionnaire were imported into SPSS software, and Cronbach's α coefficient was used to perform reliability analysis on the overall questionnaire and its dimensions, testing the internal consistency of the questionnaire. The results showed that the overall Cronbach's α coefficient of the questionnaire was 0.925, indicating that the questionnaire had high reliability and strong internal consistency, and could be used for further data analysis research. Additionally, validity analysis was conducted using SPSS software. The results showed a KMO value of 0.843 and a *p*-value of 0.000, indicating that the questionnaire is suitable for structural validity testing, suggesting that the questionnaire design is reasonable and can be used for survey research.

Through reliability and validity analysis of the pre-test questionnaire data using SPSS software, it was concluded that the Interdisciplinary Literacy Survey Questionnaire for Students possesses reliability and validity and can be used for further research. A post-test was conducted after the teaching practice, and the pre- and post-test results were entered into SPSS software for a paired samples t-test to analyze whether there were differences in students' interdisciplinary literacy before and after the teaching practice.

Descriptive statistical analysis of means and variances, as well as significance analysis, were conducted using SPSS software. First, it was assumed that there was no significant difference in students' interdisciplinary literacy before and after the implementation of interdisciplinary practical activities. The p-value represents the probability of no difference. According to statistical principles, when the *p*-value is less than 0.05, the null hypothesis is rejected, indicating that there is a significant difference in students' interdisciplinary literacy before and after the activities. Conversely, the null hypothesis is accepted, meaning there is no significant difference in students' interdisciplinary literacy. Table 7 presents the statistical analysis results of students' interdisciplinary literacy.

As shown in the table, the t-test result for the overall interdisciplinary literacy scale is $t = -4.164$, and $p = 0.000 < 0.01$, indicating that there is a significant difference in students' interdisciplinary literacy before and after the implementation of interdisciplinary practical activities. Combined with the results of the descriptive statistical analysis, students' interdisciplinary literacy in the post-test is higher than in the pre-test, indicating that students' overall interdisciplinary literacy has improved after the implementation of interdisciplinary practical teaching. From the results of the pre- and post-tests for each dimension of interdisciplinary literacy, it can be seen that after implementing the interdisciplinary talent cultivation model, the mean scores for each dimension were higher than those in the pre-test. According to the results of the paired samples t-test, the P-values for each dimension were 0.021, 0.043, 0.000, 0.038, and 0.002, respectively, all of which were less than 0.05. This indicates that the interdisciplinary knowledge level, interdisciplinary thinking ability, interdisciplinary inquiry ability, interdisciplinary collaboration ability, and interdisciplinary attitude literacy of environmental design students have all significantly improved. This indicates that implementing an interdisciplinary talent cultivation teaching model in the environmental design program has to some extent enhanced students' interdisciplinary literacy, providing a foundation for improving the quality of interdisciplinary talent cultivation in the environmental design program.

Table 7. Investigation on Students' Interdisciplinary Literacy.

Dimension	Test	Means	STD	t	P
Interdisciplinary knowledge	Before	3.516	0.832	-3.415	0.021
	After	3.982	0.618		
Interdisciplinary thinking ability	Before	3.637	0.935	-2.179	0.043
	After	3.954	0.561		
Interdisciplinary inquiry ability	Before	3.453	0.936	-3.238	0.000
	After	3.971	0.571		
Interdisciplinary cooperation ability	Before	3.628	0.938	-3.205	0.038
	After	4.029	0.624		
Interdisciplinary attitude	Before	3.453	0.995	-3.247	0.002
	After	4.083	0.476		
Total scale	Before	3.537	0.583	-4.164	0.000
	After	4.004	0.405		

4.3. Environmental Design Teaching Quality Assessment

4.3.1. Sample Data on the Quality of Experimental Teaching

Reference existing literature and university professional assessment standards to determine experimental teaching quality evaluation indicators, including teacher quality, teaching attitude, teaching design, teaching content, teaching methods, and teaching ability. University teaching quality scoring sheets are used to invite teaching experts, relevant teachers, classroom observers, and students to score the teaching staff. Then, evaluation samples with consistent scores are selected as case studies. Collect 30 sample datasets, using the first 20 datasets as training data and the remaining 10 datasets as a test set. Using the aforementioned six indicators as input and environmental design interdisciplinary talent cultivation teaching quality as output, the SLIQ algorithm employs a genetic algorithm to learn from the training data and determine optimal parameters. Based on the optimal parameters, SLIQ automatically calculates various internal related parameters to establish an evaluation model for teaching quality in environmental design interdisciplinary talent cultivation.

4.3.2. Comparison of Teaching Quality Assessment Accuracy

To analyze the effectiveness of the interdisciplinary talent cultivation teaching quality assessment model for university environmental design majors based on the SLIQ algorithm, we conducted a case study using the teaching experiment data obtained in the preceding section. Additionally, to analyze the advantages of the teaching quality assessment model based on the SLIQ algorithm for data mining, we conducted a comparative analysis using standard BP neural networks and SVM teaching quality assessment models for universities on the same platform. Figure 4 shows the comparison results of teaching quality assessment accuracy under 10 sets of data for different data mining algorithms.

An analysis of the teaching quality assessment accuracy for interdisciplinary talent cultivation in university environmental design programs yielded the following conclusions:

(1) The average teaching quality assessment accuracy of the standard BP neural network was 82.08%, with the largest teaching quality assessment error. This is because its parameters are determined randomly, making it impossible to establish an assessment model that describes the complex changes in teaching quality, resulting in many overfitting points in teaching quality assessment and the worst teaching quality assessment results.

(2) The average teaching quality assessment accuracy of the SVM-based model is 88.06%, with a smaller teaching quality assessment error than the standard BP neural network. This is because the support vector machine was introduced to establish a more optimal teaching quality assessment model than the standard BP neural network, effectively describing the complex characteristics of teaching quality changes. However, due to some underfitting points in teaching quality assessment, the assessment effectiveness still needs further improvement.

(3) The average accuracy of teaching quality assessment based on the data mining SLIQ algorithm is 92.38%, significantly higher than that of the standard BP neural network and SVM. This is because the model introduced in this paper incorporates optimal classification points and DML pruning algorithms, establishing an assessment model capable of precisely tracking the complex changes in teaching quality characteristics. This overcomes some issues present in the current assessment process and effectively improves assessment effectiveness.

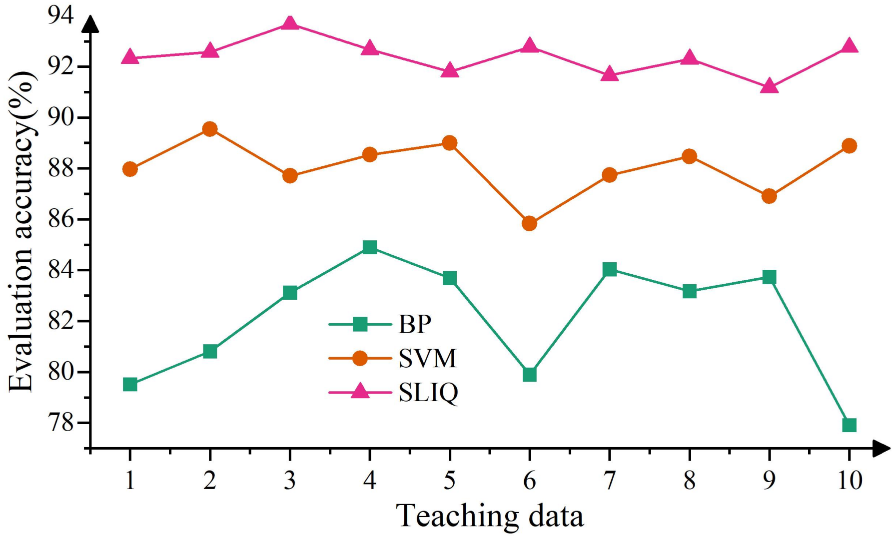

Figure 4. Comparison of the accuracy of teaching quality assessment.

5. Conclusion

In the context of new liberal arts development, it is essential to establish educational objectives that align with both the trends in the environmental design industry and the talent needs of enterprises, while also considering the individual development needs of students. This article constructs an interdisciplinary talent cultivation model for environmental design based on the aforementioned objectives and conducts a pedagogical practice analysis using students from a certain university as an example. Empirical evidence demonstrates that the interdisciplinary talent cultivation model significantly enhances the academic performance of environmental design students and further improves their interdisciplinary literacy. Additionally, the data mining SLIQ algorithm designed in this paper achieves an evaluation accuracy of 92.38% for assessing the quality of interdisciplinary talent cultivation in environmental design programs, providing support for optimizing interdisciplinary talent cultivation strategies in this field. Therefore, in the future, it is necessary to further integrate new technologies into environmental design programs, thereby blending multidisciplinary approaches with environmental design to better enhance the quality of talent cultivation in higher education environmental design programs, thereby meeting the talent needs of the environmental design industry.

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