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Exploration of Interdisciplinary Project-based Learning in Junior High School English under the STEAM Philosophy

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Abstract: The new curriculum standard for compulsory education proposes an interdisciplinary philosophy, emphasizing the integration of different disciplines. STEAM, as a new educational philosophy, provides guidance for teachers to implement interdisciplinary philosophy and students to engage in interdisciplinary learning. Project-based learning provides an effective way for teachers to conduct interdisciplinary teaching based on the STEAM educational philosophy. Through the text analysis method, the study first introduce the connotation of the STEAM philosophy and project-based learning, then discusses the project-based learning model of STEAM education philosophy, and takes the fifth unit of the ninth grade in People's Education Press as a case study to explore how to carry out interdisciplinary project-based learning under STEAM philosophy, providing reference for teachers to conduct interdisciplinary English teaching. This study demonstrates the connection between project-based learning model under STEAM philosophy and English subject and that STEAM philosophy can be integrated with project-based teaching and can effectively cultivate students' interdisciplinary learning abilities.

Keywords: STEAM, project-based learning, Interdisciplinary, Junior high school English

Introduction

In recent years, China has attached great importance to interdisciplinary development, and experts and scholars in the field of education have also attached great importance to interdisciplinary teaching. The English Curriculum Standards for Compulsory Education (2022 Edition) mention that in terms of curriculum content structure, it is necessary to strengthen the interconnection between disciplines, drive the comprehensive implementation of the curriculum, strengthen practical requirements, and establish interdisciplinary thematic learning activities[1]. STEAM, as an emerging educational philosophy with interdisciplinary integration as the core philosophy, project-based teaching as the teaching method, and information technology as the teaching method, is in line with the interdisciplinary teaching philosophy advocated in the new curriculum standards. It plays a guiding role in cultivating students' interdisciplinary learning ability and problem-solving ability, and helps to promote the development of their higher-order thinking ability.

1. Project-based learning model guided by STEAM philosophy

1.1 STEAM philosophy

STEAM is developed from the STEM education strategy of the US government. STEM corresponds to the first letters of four subjects in English: science, technology, engineer, and math. In 2010, scholar

Georgette Yakman first proposed incorporating A (art) into STEM, incorporating humanities and arts disciplines such as art, language, music, society, etc. into the broad scope of A. Since then, STEM education has expanded to STEAM education. The philosophy of integrating art into STEM advocated by Georgette Yakman is the organic integration of humanities and natural sciences, achieving the integration of humanities and natural sciences.

1.2 Project-based learning

Project-based learning can be defined as a constructive teaching and learning model, where teachers use project-based approaches as a carrier to guide students to ask questions based on real-life situations, and use relevant knowledge and information to conduct research, design, and practical operations. Finally, problem-solving and sharing of project results are carried out[2].It has five characteristics: product leadership, situational authenticity, overall systematicity, team collaboration, and progressive exploration[3].The process of project-based learning mainly includes five key steps: identify the problem to be explored; develop corresponding exploration plans; implement project exploration; exchange project results; summarize and evaluate the project.

2. Interdisciplinary project-based learning of junior high school English under the guidance of STEAM philosophy

Based on the project oriented elementary school STEAM design and development process design diagram proposed by Yuan L and Wang JBL[4], combined with the STEM interdisciplinary project design mode proposed by Yu SQ and Hu X[5], and with slight modifications, a middle school English interdisciplinary project-based learning mode based on the STEAM education philosophy is derived. As shown in Figure 1.

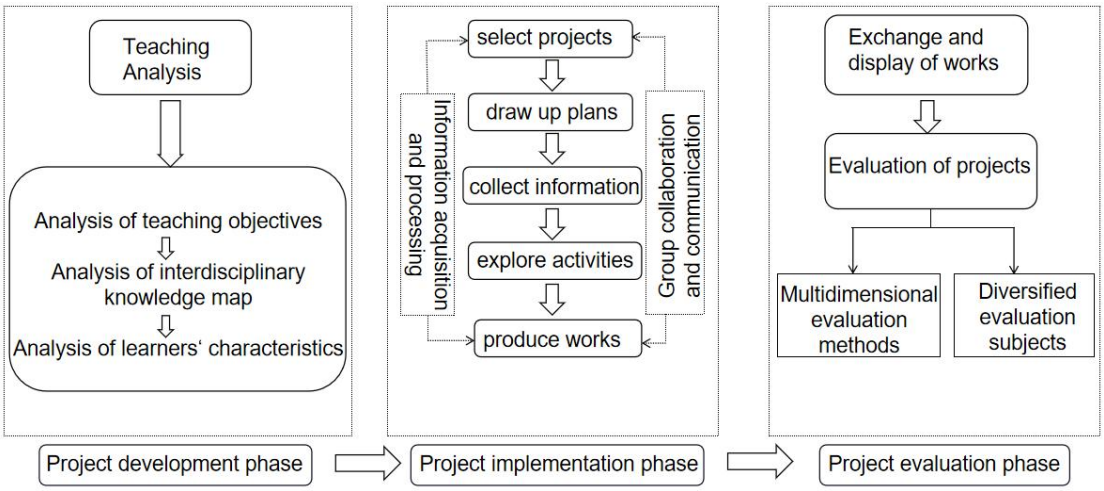


Figure 1 The Interdisciplinary Project-based Learning Model of Middle School English under the STEAM Philosophy

3. Design and analysis of a case study of interdisciplinary project-based learning mode for junior high school English under the guidance of STEAM philosophy -Take "What are the shirts made of?" as an example

3.1 Project development phase

This case design is selected from the ninth grade English textbook *Unit 5 What are the shirts made of?* published by People's Education Press. The theme of this unit is products made in China. Based on the unit

theme, STEAM education philosophy, and project-based learning model, the author has set the project-based learning theme of this unit as “Transforming Waste into Treasure - Initial Experience of Fashion Design”.

3.1.1 Analysis of teaching objectives

The design of teaching objectives is based on the teaching objective system proposed by scholars Qin DZ and Qin JR[6]. They proposed a teaching objective system of STEAM education philosophy. The entire teaching objective system with STEAM education philosophy presents a semi-circular shape, consisting of four circles including double-base layer, problem-solving layer, disciplinary thinking layer, and high-order ability layer including three aspects of cultural foundation, independent development and social participation. Based on this system, the teaching objectives can be designed as follows.

Table 1 Teaching Objectives of the Interdisciplinary Project-based Learning Model for Junior High School English based on STEAM Philosophy

Layer	Teaching objectives
double-base	Write a product project plan Describe clothing products (production process, producer, origin, materials, functions, and creative aspects.）
problem solving	Promote clothing products produced Develops skills of problem analysis and problem solving
discipline thinking	S:Cultivate awareness of environmental protection and resource conservation T:Understand simple tools and techniques of clothing production to enhance hands-on ability E:Product a project plan, draw simple clothing design sketches, and make environmentally friendly clothing A:Design beautiful and creative clothing products, enhance the aesthetic ability to discover, appreciate, and create beauty. M:Measure and plan the size, proportion, and size of clothing products, price clothing products reasonably, use mathematical knowledge to sell clothing products, and cultivate rigorous mathematical thinking
higher-order abilities	Appreciate the importance of scientific work and cultivate a rigorous scientific spirit Improve independent and collaborative learning skills Enhance practical ability and innovative spirit

3.1.2 Analysis of interdisciplinary knowledge

This project covers interdisciplinary knowledge such as design, science, technology, engineering, art, and mathematics, and has strong practicality. The interdisciplinary knowledge distribution of this project is shown in Table 2.

Table 2 Analysis of Interdisciplinary Knowledge

Discipline	Knowledge distribution
(S)Science	Selection of environmentally friendly materials environmental knowledge
(T)Technology	Basic knowledge of using clothing production tools and clothing production technology
(E)Engineering	Knowledge of clothing product design and production

(A)Art	The selection of clothing products' colors, styles, and functions, as well as the a esthetics and creativity of the product
(M)Math	Measure proportion and size of clothing products; price clothing products reasonably and use mathematical knowledge to sell clothing products

3.1.3 Analysis of learners' characteristics

After two years of English learning, ninth grade students have developed a certain level of English language literacy. In terms of oral expression, students are able to use the vocabulary and sentence structures they have mastered to express their thoughts and opinions. In terms of writing skills, students are able to use appropriate writing techniques to organize sentences and paragraphs. In terms of learning ability, ninth grade students have a certain degree of independent learning, proactive exploration ability, can actively and independently formulate learning plans, and can discover problems in practice and apply what they have learned to analyze and solve problems. They can complete learning tasks through group collaboration and has a good spirit of collaboration. In terms of interdisciplinary knowledge and abilities, after two years of learning mathematics, science, art, and physics, students have accumulated a certain amount of interdisciplinary knowledge, formed and developed interdisciplinary abilities, and can reasonably integrate these interdisciplinary knowledge with English language knowledge.

3.2 Project implementation phase

The entire project implementation process is divided into five basic stages: selecting the project, developing a plan, collecting information, exploring activities, and creating works. The specific operations are shown in Table 3.

Table 3 Project Implementation Phase

Phase	Teacher's activities	Students' activities
Select projects	Situation setting:Serious climate change and environmental pollution issues: Carbon peaking and carbon neutrality; Japan discharged nuclear sewage into the ocean; Assign project: Turn waste into treasure and design environmentally friendly clothing products.(shirts；shorts；dress；caps；socks；shoes；bags；gloves...); Present a template for the English project plan;	Describe the clothing they want to design and the reasons; Clarify the project learning tasks Plan the tools, materials, and process required to complete the project.
Draw up plans	Allow students to group themselves (in groups of six), assign project tasks, and complete the plan.	Collaborate to write the project plan Clarify the division of project tasks

Collect information	Play an English video of environmental clothing design and production (with bilingual subtitles); Present some pictures about environmental clothing; Provide materials and tools for clothing production.	Watch videos and pictures Improve the previous project plan Select the required materials and tools
Explore activities	Activity 1: Presents a sketch template for clothing design; Ask students to pay attention to measuring the size, proportion, size, color, and other aspects of clothing when sketching. Activity 2: Explain the tools (scissors; glues; pens...) and materials (paper; glass; plastics; cotton; steel; cloth...) of environmentally friendly clothing; Demonstrate the production process of environmentally friendly clothing by a flowchart.	Activity 1: Design personalized clothing sketches in groups; Activity 2: Listen carefully to the teacher's explanation, learn vocabulary, expressions and understand the production methods and techniques of environmentally friendly clothing.
Produce works	Inspect and guide students in groups Provide feedback to students.	Finish the products in groups based on sketches and the use of production methods (During the production process, consider the environmental friendliness, feasibility, practicality, aesthetics, and creativity of the product.)

3.3 Project evaluation phase

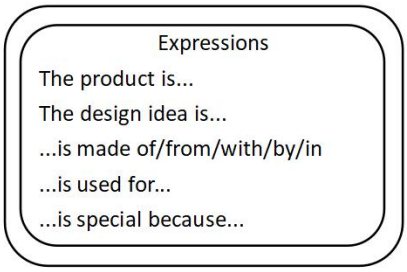
The project evaluation phase is a crucial step in determining the achievement of project goals. In the project evaluation phase, the evaluation subject and the evaluation methods should be diversified. The specific content is shown in Table 4.

Table 4 Project Evaluation Phase

Phase	Teacher's activity	Students' activity
Exchange and display of works	Encourage students to communicate and show their manufactured products through the "Clothing Exhibition" activity; Present several questions and provides some expressions(as shown in the following figures)	Report their products and mark the price for sale(When reporting, pay attention to the fluency and accuracy of language, the richness of content, the clarity of logic, and the completeness of structure.) Use sentence structures when selling, such as:"What can I do for you?/How much is...?/

It is ...yuan...”

What the product is?	
What the design idea is?	
What it is made of?	
Who it is made by?	
Where it is made?	
What it can do?	
Why it is special?	



Evaluation of projects (Evaluation forms can be found in Tables 5 and 6)	Teacher-evaluation	Self evaluation and peer evaluation

Table 5 Formative Evaluation

	Teacher-evaluation(0-10)	Self-evaluation(0-10)	Peer-evaluation(0-10)
Writing of proposal project			
Drawing of sketch			
Group work			

Table 6 Summative Evaluation

Dimension			Teacher-evaluation (0-10)	Self-evaluation (0-10)	Peer-evaluation (0-10)
Product	Eco-friendliness				
	Practicability				
	Creativity				
	Aesthetic				
Presentation	Language	Fluency			
		Accuracy			
		logicality			
		Body language			
	Content	Richness			
	Structure	Completeness			
		Cohesiveness			

Teachers, students, and peers rate the dimensions above separately in the tables of formative evaluation and summative evaluation, reflecting the objectivity of evaluation.

4. Conclusion

The STEAM educational philosophy provides guidance for project-based learning in junior high

school English. Based on this philosophy, interdisciplinary project-based learning in junior high school English can help students acquire interdisciplinary knowledge during project development, project implementation, and project evaluation. Therefore, English teachers in junior high schools should apply the STEAM philosophy to practice project-based teaching, while also constantly exploring and researching more optimized subject integration teaching methods to help the effective integration of the English subject with other subjects.

Conflicts of interest

The author declares no conflicts of interest regarding the publication of this paper.

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