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STEAM Activity Design Based on 4C Education Concept

-Take tie-dye of traditional culture as an example

Yanan Yang[1], Wenfa Yan[1, 2], Yaru Yang[1]

[1]School of Chemistry and Chemical Engineering, Shaanxi Normal University, Xi 'an 710119, Shaanxi;
[2]Key Laboratory of Modern Teaching Technology, Ministry of Education, Shaanxi Normal University, Xi 'an 710119, Shaanxi Province

ABSTRACT. *STEAM education is a new educational paradigm to cultivate students' problem-solving ability and innovation ability in a multi-disciplinary way. At present, countries all over the world pay attention to promoting the integration of disciplines and developing students' comprehensive abilities, emphasizing the use of multidisciplinary knowledge to solve problems in real situations. This article is based on 4C concept, combined with the case analysis of tie-dyeing process of Chinese traditional excellent culture, in order to provide a new path for STEAM education curriculum design, provide a reference model for traditional education into the classroom, and lay a foundation for training comprehensive and innovative talents.*

KEYWORDS: *STEAM education; 4C concept; Traditional culture; Tie dyeing process*

STEAM education is the acronym of Science, Technology, Engineering, Art and Mathematics education. STEAM education is not a simple superposition of science, technology, engineering, art and mathematics, but an effective integration of them into an organic whole. It takes real problem solving as its task drive, acquires knowledge and applies knowledge in practice, and trains students' problem solving ability, compound thinking and innovative thinking. The United States attaches great importance to the advantages and disadvantages of extracurricular STEM programs for young people, and has incorporated STEM educational results into important evaluation categories [1].In recent years, STEAM education has gradually entered the classrooms of primary and secondary schools in our country. More and more schools have incorporated STEAM education into their core curriculum or extended curriculum. However, in the specific implementation process, STEAM education still has some practical problems. For example, there are few models and supports that can be used for reference in curriculum design, resulting in most STEAM courses failing to achieve their real educational goals, thus impairing the educational effectiveness of STEAM education itself. Lego 4C teaching concept provides a good

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model and support for STEAM curriculum design. Teachers can directly refer to 4C model to carry out STEAM curriculum design[2],and STEAM educators improve their STEAM knowledge and skills while continuously challenging their previous experience and experience through reflection[3].

1 The basic connotation of STEAM education

STEAM education is an educational model extending from STEM education. With the development of STEM education practice research, Arts (Art) courses have been added to STEM courses[4].Since the 1990s,STEAM education has gradually swept all countries, especially in the developed countries such as the West. The scientific literacy, technical literacy, engineering literacy, artistic literacy and mathematical literacy it points to are regarded as the core literacy necessary for innovative talents in the new era.

2 4C Education Concept

4C teaching method is a teaching method that combines Lego education with Piaget's constructivism theory and is designed according to the characteristics of students' knowledge acquisition and learning effect in the long-term educational practice.4C teaching method divides the teaching process into four stages: connection-construction-contemplate-continue,as shown in Figure 1.

(1) Connection refers to creating a real problem situation,guiding learners to establish a connection with new knowledge based on existing knowledge and experience,actively discovering problems,and stimulating learning interest and subjective initiative.

(2) Construction has two meanings:one is the construction of physical models in a simple sense,which promotes learners' participation and hands-on ability in the process of physical construction;The second is the construction of knowledge level:the process of "assimilation" and "adaptation" is also taking place constantly in the process of exploring true knowledge,and the existing "schema" is continuously perfected in the mind.

(3) Contemplate is the reflection stage of the construction process.It is an important stage of refining knowledge and realizing innovation to find out the existing problems in the process of discussion and communication,and gradually calibrate the scheme and optimize the learning results.

(4) Continuation is the process of application and transfer of the learned knowledge and skills.Based on the learned knowledge and skills, students find the connection points of new problems,thus entering a new round of"connection-construction-reflection-expansion" links.

This shows that the four links are not a single linear structure,but a process of interlocking and dynamic circulation.

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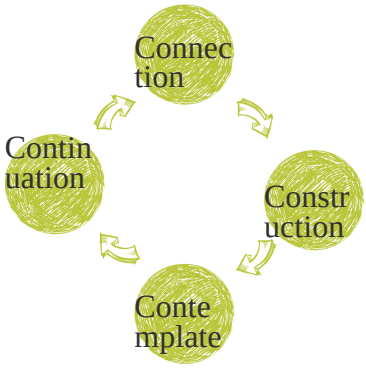

Figure 1 Lego 4C Teaching Concep

3 "Tie Dyeing Process" STEAM Activity Design Based on 4C Education Concept

3.1 Background of Topic Selection

At present, China's excellent traditional culture education has jumped to the strategic height of "cultural power".It has become the consensus of the domestic education circle to promote the excellent traditional culture to enter the campus.Tie-dyeing technology is a good carrier to infiltrate cultural confidence education. Choosing traditional cultural tie-dyeing technology as the activity content can not only stimulate learning enthusiasm and promote students to transfer existing knowledge and skills to real problem situations to solve real-life problems, but also the open curriculum implementation and dynamic curriculum content can help students improve their cognitive ability and ability to efficiently solve real problems[5].Based on this, this activity takes tie-dye art of Chinese traditional culture as the carrier, integrates 4C educational concepts to carry out STEAM activity design, connects traditional culture with the classroom, and trains comprehensive talents needed in the 21st century on the basis of inheriting and developing Chinese excellent traditional culture.

3.2 Brief Introduction of Tie Dyeing Process

Tie-dye,known as tie-dye and tie-dye in ancient times, has a history of about 2,000 years in China and was listed as the first batch of intangible cultural heritage in China in 2006(2006,No. VIII-26).Tie dyeing process mainly includes three steps: pre-dyeing, binding dyeing and post-dyeing. The specific process flow is as follows: design concept-fabric selection-pattern drawing-binding-soaking-dyeing-rinsing-thread removal-rinsing-air drying-ironing-completion. The desizing and dyeing processes in the process

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involve chemical and chemical industry, bioengineering, monitoring and analysis,art appreciation,etc.,perfectly integrating the five aspects of science, technology, engineering, art and mathematics.

3.3 Activity Objectives

At the level of scientific (S) knowledge,the interdisciplinary integration is realized by taking the knowledge of chemical disciplines such as"redox reaction"and"organic chemistry"as the main line and simultaneously taking into account the knowledge of physics,biology and other disciplines.

On the technical(T)level,master the principles of the four technical methods needed for desizing and the operation of several major processes of tie-dyeing,such as tie-dyeing,dip-dyeing, bleaching and air-drying,so as to enhance students' practical operation ability.

At the level of engineering(E)problems,the core issues raised by engineering thinking are used to optimize the technical means continuously according to each process of tie-dyeing process and the situation in team cooperation.

On the level of art(A),students can experience the extensive and profound Chinese traditional culture through hands-on practice,enhance their national self-confidence and awareness of the protection and inheritance of traditional culture, and penetrate cultural self-confidence education to students.

On the level of mathematics(M),through exploring the factors affecting desizing speed, reasoning and analysis are carried out by using mathematical thinking,thus improving students' mathematical application ability.

3.4 Activity Design

The implementation process of the activity is formed by nesting 4C educational concepts and scientific inquiry activities.It includes"creating situations,learning and research,inquiry and design, testing and optimization,display and evaluation"and forms the integration of "teaching,learning and evaluation".The activity implementation plan and class hour arrangement are shown in Table 1,which is carried out through group cooperation and independent inquiry.

Table 1 "Tie Dyeing Process" Activity Flow

Program	Link setting and class hour arrangement	Activity design	Design intent	Data Card
Connection	Create a situation (Class 1)	[Teachers]Introduce tie-dyeing technology and its cultural history to students through pictures or short videos. [Teacher]Introduce the causes of fabric sizing and the types of	Through the introduction of pictures or videos, create real problem	(1)Before weaving,the fabric should be treated with sizing to improve the strength of the warp yarn.Therefore,the fabric often contains sizing agent and oily components,which will cause color fading or color spots if not removed.

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		sizing agents to students.Ask students to contact experience and think about what factors to consider when selecting desizing agents.What kind of properties should be considered in the selection of desizing agent? What are the factors that affect desizing speed? [Students]Form"Engineering Design Team"to carry out discussions and exchanges within the team,and initially construct the problem solution and overall activity framework based on the existing experience.	situations and drive students to think actively.	(2)Type of size:natural size (starch);Chemical slurry; Starch slurry;Cellulose (3)desizing:i.e. removing the slurry,generally boiling the slurry with alkali solution, oxidant or amylase to about 80°C,and desizing the fabric.
Construction	Learning and Research (Class 1)	[Preparation]Distribute utensils to the"Engineering Design Team":fabrics of different fabrics,commonly used desizing agents, thermometers,needle and thread,scissors,etc. [Teachers]Guide students to combine the types of sizing agents and the properties of desizing agents,and give corresponding desizing agent schemes based on the given data and subject knowledge such as chemistry and biology. In combination with the discussion results,select appropriate desizing agents for fabric desizing to complete pre-dyeing treatment. [Students]Complete Inquiry Experiment:1.Explore the fading principle of desizing agent 2.Explore the factors affecting desizing speed	Through the const uction of physical models, the best desizing agent for different fabrics and its dosage are deter mined,so as to dev elop student s' mathematica l analysis, information management and knowledge transfer capabilities.	Four common desizing methods: (1)hot water desizing method: after the fabric is soaked in hot water, it is piled up for more than ten hours to make the slurry swell and easy to be washed away by water. (2)alkali desizing method: starch can swell under the action of sodium hydroxide solution, and the concentration is usually 10-20g/l.(3)enzyme desizing method:amylase is a biochemical catalyst,calcium chloride and sodium chloride are often added as activators to improve the activity of the enzyme,and the temperature is 40-50 DEG C.(4)oxidant method: multiple oxidants are applicable.For example,starch and polyethylene can be degraded in alkaline sodium peroxide solution with a concentration of 3-5g/l.
Construction	Inquiry and Design (Class 2)	[Teachers]Through modeling and exploring activities,think about and answer the following questions(1)What is the greatest difficulty in the process of inquiry?(2)Give the most reasonable scheme and reasons [Students] communicate and discuss among groups, reflect and optimize the construction process, and improve the problem-solving ability. [Teachers] Instruct the students to finish the pretreatment of fabrics.Take indigo,the most commonly used dye for tie	Asking questions enables students to think about the process of buildi ng the model and to carry out, discuss and impr ove the plan.	Indigo structure:Indigo has a simple monomolecular structure and a lamellar crystal structure.The molecular structure of single-molecule indigo and double-molecule indigo in the same plane and the distance between atoms are shown in figure (a)

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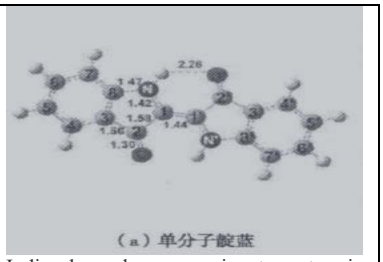
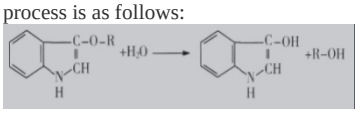
		dyeing of Bai nationality in Yunnan Province,as an example,to give the chemical structure of indigo,guide the students to analyze the structure and deduce the relevant chemical properties and dyeing mechanism of indigo. [Students]Use computer technology to search relevant documents,discuss and communicate,and finally give the optimized plan.		 （a）单分子靛蓝 Indigo has a large π conjugate system in its molecule and hydrogen bonds exist in and between molecules,which makes indigo have high stability,high melting point and poor solubility.
Continuation	Testing and Op timization (Class 3)	[Teacher]In the actual production process,hydrogen peroxide or sodium peroxide is often used for bleaching treatment.What is its principle?Can you replace it with other bleach?Why? [Students]Review Old Knowledge and Solve Problems $Cl_2+H_2O⇌HClO+HCl$ $2HClO=2HCl+O_2$ $Na_2O_2+2H_2O=4NaOH+O_2↑$ $Ca^{2+}+3ClO^-+SO_2+H_2O=Cl^-+CaSO4↓+2HClO$ $Ca^{2+}+2ClO^-+2SO_2+2H_2O=2Cl^-+CaSO4↓+SO4^{2-}+4H^+$	To guide students to transf er their knowledge and introduce students into a new round of contact-cons truction-refl ection-expan sion, so that students can further experience the reflection process of engineers.	Common bleaching agents include activated carbon, chlorine water,bleaching powder,Na_2O_2, O_3, H_2O_2, SO_2, etc.Indigenin contained in indigo is a condensate of indanol and glucose.The principle of reduction dyeing process is as follows:  After lime is added,lime dissolves in water to generate calcium hydroxide,which makes the leaching solution alkaline $CaO+H_2O=Ca(OH)_2$; At the same time,calcium hydroxide reacts with carbon dioxide gas produced by fermentation to produce calcium carbonate precipitation, which accelerates the precipitation of $Ca(OH)_2+CO_2=CaCO_3↓+H_2O$
	Display and evaluation (Class 3)	[Teachers]Please ask each group to reflect and summarize the activity process,and show the tie-dye finished product finally designed,and advocate students to conduct self-evaluation and mutual evaluation. [Students]Collect the exchange results,organize students to share the exchange results,and select the best tie-dyed fabric.	To enable students to experience the extensive and profound traditional tie-dye culture of the Chinese nation.	

4 Discussion

General secretary Xi Jinping pointed out in the party's 19th congress report that"culture prospers while culture strengthens".he reiterated that"without a high degree of cultural confidence,without cultural prosperity,there will be no revival of the Chinese nation."he stressed that"we must adhere to the path of development of

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socialist culture with Chinese characteristics, stimulate the creativity and vitality of the whole nation's culture,and build a socialist cultural power".at the same time,he also pointed out that the excellent traditional Chinese culture is the source of socialist culture with Chinese characteristics[6].Compared with traditional subject-based teaching, STEAM education advocates the application of interdisciplinary knowledge to solve problems in real situations and provides a good educational model for the integration of traditional culture into the classroom.The tie-dyeing process of traditional culture is organically integrated with STEAM education.On the one hand,in the process of active participation and experience learning,students not only acquire the multidisciplinary knowledge carried by the tie-dyeing process of traditional culture,but also improve the ability of problem solving and practical innovation in the process of exploration and discovery,transforming static knowledge teaching into dynamic ability training. On the other hand,in the process of STEAM education,traditional culture education is infiltrated to cultivate students' correct traditional cultural values and enhance students'sense of responsibility and mission to protect and inherit traditional excellent traditional culture.Traditional culture education based on STEAM education not only conforms to the new ideas of scientific research in our country,but also provides a feasible educational paradigm for traditional culture to enter the classroom.

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