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Dance as a Creative Gateway to STEAM Education Practice——Take the Chinese Classical Dunhuang Dance as an Example

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Abstract. STEM education emerged in the United States before 1990s, aiming to cultivate scientific and technological talents and improve students' scientific literacy by integrating Science, Technology, Engineering and Mathematics. STEAM is a creative art course with true interdisciplinary integration by adding Art elements to enrich the knowledge covered by STEM courses. This paper integrates Dance into STEAM education, analyzes the new impetus of STEAM dance course in dance education, and designs a STEAM-based dance course with Chinese Classical Dunhuang Dance . Surveys are distributed to determine how parents of teenagers feel about this dance course. The study could enrich contemporary dance curriculums, cultivate scientific and artistic talents, improve the quality of dance education, and promote the development and progress of STEAM education in China.

Keywords: Dance ; STEAM ; Chinese Classical Dunhuang Dance; Embodied Learning.

1. Introduction

For educators and researchers working with teenager, Science, Technology, Engineering, and Mathematics (STEM) education is increasingly important. According to Maeda (2012), the integration of Science, Technology, Engineering, Arts, and Mathematics (STEAM) serves to develop creative thinking and twenty-first-century skills in the classroom. To help illustrate our aims， this article provides a definition of STEAM education, in which the "S" is a system of knowledge that reflects the objective laws of nature, society and thinking; the "T" is a general term for the tools, methods and experience of problem-solving; the "E" is the use of scientific principles and technical means to create artificial objects in the process; the "M" is the study of spatial forms and quantitative relationships of a science; and the "A" represents not just visual arts, but a broad range of humanities, including liberal arts, language arts, history, dance, painting, etc. In a word, the goal of this work is to provide readers with examples of how dance like Chinese Classical Dunhuang Dance can facilitate STEAM learning naturally that can easily tie in with content educators are already teaching.

"Dance is one of the forms used in STEAM education practice." In a previous study, Walker (2018) has suggested that STEAM education is closely associated with Dance. For example, dancers need to imitate certain angular shapes to complete movements. Therefore, dance is believed to be a way to learn STEAM education practice and cultivate people's adventurous spirit and creative problem-solving ability. At the same time, dance as a kind of art promotes social, teaching, and makes us feeling better (Walker, 2018). "SHINE for Girls" were selected as part of HundreED's 100 Global Education Innovations in 2017. A nonprofit with the mission of empowering all teachers to value their own potential and capabilities within STEM fields, employs a unique curriculum that blends math with dance. (Hally & Sinha, 2018)

Dance is a particularly suitable means of achieving educational aims. It helps to develop physical flexibility, to cultivate aesthetics, to develop imagination, creativity and intelligence, to deepen and externalize emotions, to learn to enjoy life and to broaden one's social abilities. Dance has a great role to play in education, combined with social studies and music (Pruss, 1940). Dance education can have a direct developmental effect on teenagers. In addition, it allows teenagers to participate in

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other activities in a more active way and dance education can be used as a basis for other educational fileds.

Many people have some misunderstanding of dance education and dance training. (Koff, 2000) Learning dance is not necessarily to become an actor. Meanwhile, Dance can help resolve the problem, such as student's innate desire for action. Dance can be an expression of deep emotion, but it is also a purely physical movement (Snoeyenbos & Knapp, 1979). Dance education should be a compulsory course and become the basic art course for all students. In the innovative education of dance, the curriculum design has included: teaching dance, planning lessons, and creating curriculum plans (Berardi, 2021). In such a teaching design, it will be different from the previous dance courses, not only strengthening students' dancing ability, but also integrating a broader knowledge learning, which is also the future development and design direction of dance practice.

2. The design of teaching plan in STEAM (Chinese Classical Dunhuang dance)

The research subject of this paper integrate STEAM-based concept into traditional dance practices. This creative style of Dance Curriculum is designed to be divided into dance performance skills and other STEAM-based dancing programs. This paper elaborates on the design of other STEAM-based dancing programs from the perspective of Science、Technology、Engineering、Arts and Mathematics,respectively. To put it in this way, the STEAM-based dancing programs set up students-centered learning environment. With teachers guidence, students gain some related scientific knowledge, make dance props by themselves, etc. Innovative dance course cases are formed to supplement traditional dance courses and provide references for other dance courses design, guiding teachers to explore STEAM-based teaching elements that can be carried out in various dance courses.

2.1 Science in a Dance class

From a natural point of view, Dunhuang murals are drawn using a variety of pigments that originated from both natural minerals and synthetic materials (Yin, et al., 2019). The common stone color and a few chemical pigments in Dunhuang frescoes are cinnabar, silver, ochre, earth red, stone yellow, realgar, etc, and the pigments used in Kizil Grottoes frescoes in Xinjiang, China are mainly Vermilion, Lapis Lapis, Atacamite, PbO2, and other ore pigments; Compared with the part of the Dunhuang frescoes in the Southern and Northern Dynasties, they are basically the same. The difference is that, at this time, the stone color and a few chemical pigments in Dunhuang appeared a large number of red soil, a small amount of Azurite,Malachite Green, but Kizil stone window is relatively few or no. (Zhuxiong Li , 2002)

In addition, the study shows that the use of pigment is related to the local art style, painting techniques, the local natural production conditions and environment. (Rongjian Wu, 2003) As a foreign art，Buddhist is a new art form. It must adapt to the local customs and natural production conditions，integrating with the ethnic art styles in local region. After analysizing, the skin color of Dunhuang fresco figures is not lead powder. Talc or clam powder, which will not change color, is mixed with a small amount of ZhuDan, which will change color easily. ZhuDan oxidized to black, a small amount of black mixed with a large amount of white to lead gray, causing early figure painting discoloration. In the mural, the part dyed by concave-convex method turned black after dyed with a layer of ZhuDan, forming a distinct black and white gray with the eyelid and nose bone. Based on the understanding of the above background knowledge, teachers can guide students to design a scheme to prevent the discoloration of mural paint from the perspective of humidity, light, water and CO2. Teachers need to provide students with a scaffold to complete the task, and encourage students to find information to complete the task.

From a social point of view, Chinese Classical Dunhuang Dance from Dunhuang Mogao Grottoes Buddhist art murals, is a contemporary art of dance. Dunhuang Dance is divided into three categories: The first one describes social life, customs and habits of the dance scenes as well as

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dance images. The second category represents Buddhist fairy music and dances, which aims to promote religious Dogma. The third category shows scenes of Buddhist rituals. (Yuping, 2022) In the process of dance teaching, teachers can use online media to introduce students to the first category of Dunhuang Dance, which vividly depicts life customs of different times and regions in Dunhuang.

2.2 Technology in a Dance class

There are many leather and wood percussion instruments in Dunhuang murals, of which the Waist Drum is the preferred choice for mural percussion, and has been used frequently in murals of all dynasties since it first appeared on the north wall of Cave 272 in Northern Liang Dynasty, as shown in Figure 1. (Zhuang Zhuang, 2002) Thin Waist Drum is one of the props used in Dunhuang dance to enhance the spectacle and rhythm of the dance. In Dunhuang dance fields where the drum is used, dancers often incorporate mock two-handed drumming.

The Waist Drum, in Dunhuang murals, also uniquely known as the Thin Waist Drum, has a frame made of wood, tile and pottery, thick at the ends and thin in the middle, and the Thin Waist Drum in Dunhuang's murals are smaller in size, with symmetrical left and right frames, due to Indian influence. (Yufei Zheng, 2020) Once these basics are understood, teachers can guide students to make their own drums based on pictures and video materials of Thin Waist Drum in Dunhuang to increase their own understanding of the drums and Chinese Classical Dunhuang Dance.

Figure 1. Thin Waist Drum in the Variations on the Sutra of Immeasurable Life on the south wall of Cave 25, Yulin Cave, Dunhuang Mogao Grottoes

2.3 Engineering in a Dance class

Using the techniques of Thin Waist Drum-making and pottery-making, students can create their own drums by drawing blueprints, making raw embryos, painting, secondary firing, masking and painting the surface of drums. The process is shown in Figure 2, in which they can experience the beauty of traditional Chinese culture and express their feelings with their own designed patterns and eventually produce a finished product to be used in the final dance performance to make it more attention-grabbing and culturally meaningful.

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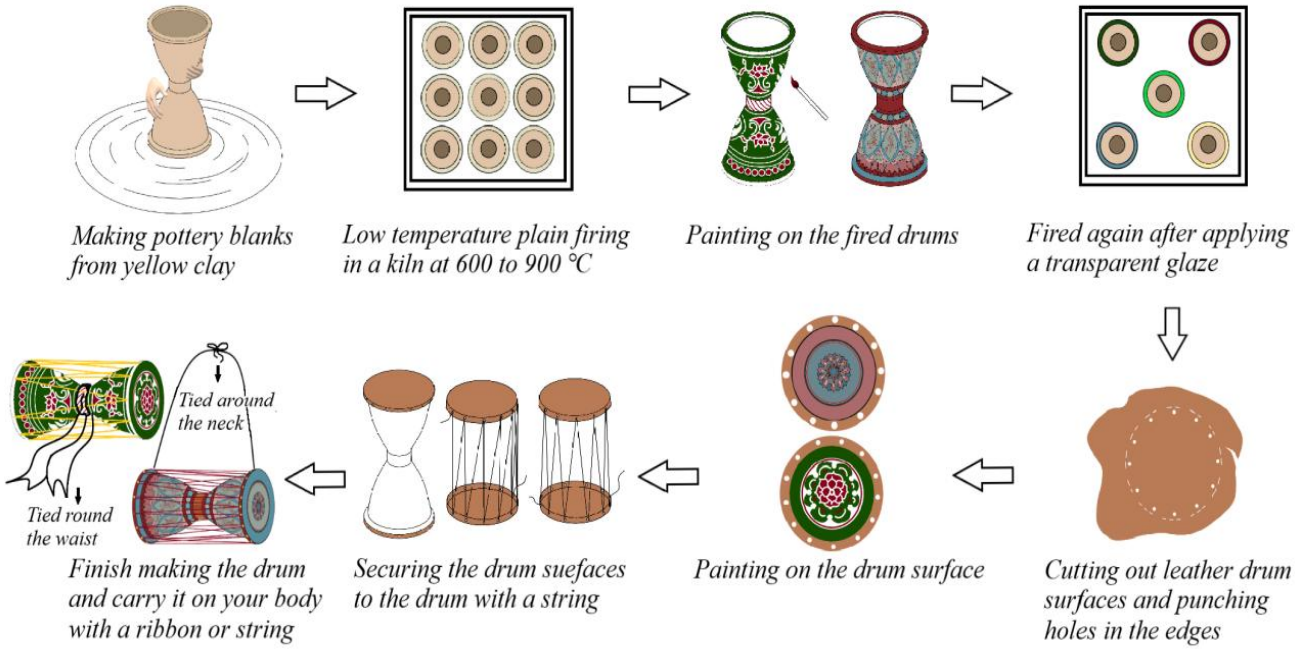

Figure 2 Flowchart for making a Thin Waist Drum

2.4 Arts in a Dance class

2.4.1 Art appreciation——Thin Waist Drum

The art in the Dunhuang Thin Waist Drum is mainly expressed in the drum shape, patterns, colours, knot patterns and the combination of the four, as shown in Figure 3, where the Thin Waist Drum is a whole of various patterns, colours and components combined. In addition to this, when used in dance, the Thin Waist Drums are used in conjunction with music and dance movements to create a new aesthetic experience. For example, the patterns on the drums complement the dance movements and costumes, and in some Chinese Classical Dunhuang Dances the dancers are required to strike a Thin Waist Drum to make a sound (Dong Dong Dong....).

Drawing courtesy of Xiaohan Chen

Figure 3 Diagram of the finished Thin Waist Drum

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2.4.2 Aesthetics Design of Dunhuang Costume

The Dunhuang clothing patterns are colorful and diverse. After the Tang and Song dynasties, the theme of Dunhuang clothing patterns mainly covers people and animals. The pattern forms are complex and diverse, with different types, including single pattern, horn-dwelling pattern and banded line, like two continuous pattern and arabesque continuous pattern. It can be said that Dunhuang clothing patterns almost include all the forms of decorative patterns. There are a lot of Dunhuang patterns that can be used in our modern design, including flying sky pattern, honeysuckle pattern, grass pattern, lotus pattern, treasure phase pattern, geometric pattern, cloud pattern, caisson pattern, animal pattern, etc.

2.5 Mathematics in a Dance class

The process of dance teaching is rich in mathematical knowledge. We would also like to add that the following mathematical knowledge applies to all dancing courses.

2.5.1 Angle

In the process of dance teaching, teachers often use "two-point" or "eight-point" to regulate the direction that dancers face. Generally speaking, there are eight points in total, each one is 45 degree apart. Dancers take the front of their body as the standard. When they turn 45° to the right, then they face the direction of "one point". Then, according to the concept of embodied learning, we can integrate mathematical knowledge into the dance teaching. For example, for students who are new to the concept of "angle", dance teachers can use point training to let students perceive acute, right and obtuse angles. In addition, for advanced students, the dance teachers can use the formation to set situational questions and divide the students into two groups. One group will line up in a set formation during class and the other part will solve the questions according to the teacher's requirements. For instance, as shown in the figure: ∠ABC is an isosceles triangle, and AB = AC, please work out the degree of ∠A. In a word, in this pleasant and interesting atmosphere, students are able to master the knowledge of "angle" in an efficient way under the pleasant and interesting atmosphere.

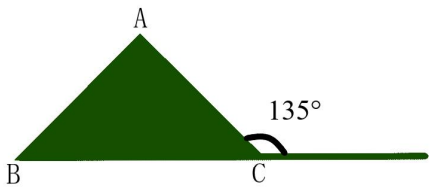

Figure 4

2.5.2 Geometric figures

Geometric figures from mathematics can be used in the collective teaching of Chinese Classical Dunhuang Dance. For example, if dance teacher wants to make up the formation for eight people, she can choreograph three types of formations, such as rectangle (four in front and four at the back) and trapezoid (three in front and five at the back). As for nine people, for example, the dance teacher can choreograph three kinds of formation, such as diamond, semi-circle, circle. Students can gradually form an intuitive perception of geometric shapes through "learning by doing", and at the same time, the formation formed by geometric figures also makes the dance more dynamic and attractive.

2.6 Evaluation

In view of the above learning contents, teachers can adopt the evaluation method of portfolio. Portfolio is mainly the collection and display of students' personal works and achievements. It is a

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tool used to capture students' growth trajectory. The portfolio can show students' progress; The portfolio has the function of promoting reflection, that is, through the comments on the portfolio, students can show their personal growth experience and reflect the advantages and disadvantages of students in the process of learning and growth.

For dance teaching under the STEAM education concept, portfolio is a combination of theoretical learning and practice, process evaluation and result evaluation, and a combination of electronic version and paper version in form. Students can complete the tasks assigned by teachers by learning a variety of knowledge in science, technology, engineering, art and mathematics, and finally form works to be put into portfolios. Dance is still the core theme of the learning process, and students are required to complete a dance recital and finally complete the learning process. Dance performances will be included in portfolio in electronic form for acceptance of learning outcomes.

3. Survey of parents' approval of teenagers' participation in Dance STEAM

As can be seen from Table 1, there were a total of 90 valid questionnaires. Most of the parents who participated in the questionnaire had children in primary schools (93.3%). For the parents of primary school students who participated in the survey, more than 90% of students are participating in extracurricular dance training and their parents actively support it. Among them, 80.95% parents actively support students to participate in dance classes incorporating STEAM-based concept, which is a high proportion. Although the sample size of the junior high school students'parents involved was small, the parents of junior high school students supported students' participation. In general, parents are receptive to dance classes incorporating STEAM-based concept.

Table 1 Parents' approval of teenagers' participation in STEAM Dance Education Practice

Items	Parents of primary school students (N = 84)	Parents of junior high school students (N = 6)
Attending extracurricular dance training classes（%）	90.48	50
Parents' attitude towards children's participation in dance training classes（%）	Positive support：91.67	Positive support：66.67
	Neutral ： 5.95	Neutral ： 33.33
	Nonsupport ： 2.38	Nonsupport ： 0
Parents' attitude towards enrolling their children in dance classes incorporating STEAM concepts（%）	Positive support：80.95	Positive support：66.67
	Neutral ： 16.67	Neutral ： 33.33
	Nonsupport ： 2.38	Nonsupport ： 0

4. Conclusion and Discussion

This paper discusses how to integrate the STEAM-based concept in the dance education practice. Teenagers' learning enthusiasm and acceptance largely depend on teachers' instructional design and teaching methods for this subject. Therefore, creative instructional design is a key factor for educational progress. Obviously, it improves students' learning ability and also greatly improves teachers' own knowledge requirements. Comprehensive application and cross-field integration of knowledge are also the progress direction of teachers in the future.

Taking Chinese Classical Dunhuang Dance as an example, the STEAM-based dance program not only stimulates students' creativity, but also allows them to immerse themselves in a new style of dance curriculum through the use of music, painting and other artistic elements. Based on

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embodied learning theory, students use their body language to express their emotions and externalize their inner feelings in the process of learning dance, which helps alleviate negative emotions and promotes the internal integration of student's body and mind. In other words, facilitating bodily STEAM-based learning at our deepest roots can strengthen our intrinsic knowledge that humans area synthesis of inner-outer, self-other, and macro-micro. Re-membering and returning to our felt senses, to our lived experiences and our Body (Buono, 2019). In conclusion, the STEAM-based dance curriculum meets the internal needs of learners, rooted in their vivid experiences, and promotes their own practical reflections. We expect this new type of curriculum to bring a better learning experience for teenagers.

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