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The Transformation and Application of Virtual and Reality in Creative Teaching: A New Interpretation of the *Triadic Ballet*

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Abstract: Virtual imaging technology has been widely used in entertainment, medicine, engineering and other fields, and the advancement of virtual imaging has also provided new opportunities for art performances and exhibitions. This research uses live dance, screen dance and virtual dance displays to conduct the audience's experience of watching dance performances and compares the three forms. A total of 30 students participated in this research. According to the results of this study, the content of the dance works includes route and trajectory, movements and expressions, costumes, and overall atmosphere; there is no obvious difference under the three viewing conditions, and the spatial performance of dance works is best in live performances. According to the research results, the physical stage performance still has the advantage of space performance, virtual image has the advantage of solving the distance between the audience and the stage, and the screen image is helpful for the performance of the stage color. The results of this study show that the presentation of different technologies can improve the audience's viewing experience of dance, but how to create an impressive spatial experience using the screen image and a virtual environment for a live performance still needs technical improvement.

Keywords: virtual and reality; dance experience; creative dance teaching

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1. Introduction

Dance is one of the most primitive languages of human expression, one of the most memorable experiences in life, and one of the first and purest forms of bodily movement. Dance scholar Susan L. Foste proposed that choreography is a set of cultural codes created from postures and movements; choreographed body movements provide an embodied method of investigating the relationship between social structure and one's agency [1]. How audiences appreciate dance performances has always been a topic of discussion related to dance aesthetics [2]. Traditionally, dance performances were viewed in person in a theater; however, this involves highly complex tour arrangements for the dance troupe and transportation arrangements for the audience. During the COVID-19 pandemic, dance troupes could not tour, and audiences were required to maintain social distancing [3]. Consequently, many theaters were forced to close temporarily, posing an enormous challenge to the performing arts industry. In response, many theaters broadcasted dance performances online, and many artists broke through the barriers of traditional theaters by using digital technology to present dance performances to audiences. For example, the Cirque du Soleil used the online platform Cirque Connect to provide exclusive performance highlights to audiences. Audiences could also view performances on the Cirque du Soleil virtual reality (VR) app [4]. In addition, The Metropolitan Opera offered free Nightly Met Opera Streams on its official website [5], and the Vienna State Opera used Wiener Straatsoper to broadcast segments of performances for free [6]. When live performances are converted into broadcasted performances, performers, and audiences, despite experiencing the performance simultaneously and spending time together, are constantly aware that the other party is not physically present and thus lack the sense of sharing the moment with each other. This

phenomenon invites discussions on the concept of "liveness" in the performing arts and the reasons that live performing arts are irreplaceable [7].

The digital display of dance performances will inevitably continue due to factors such as technological advancement, the development of digital theaters, the arrival of the metaverse, and changes to how audiences enjoy performances following COVID-19. Further investigation and research are required to understand how the viewing experience of audiences changed as dance performances transitioned from the theater to the screen. Many studies have investigated the virtual display of art. For example, Chen [8] studied paintings displayed with various media and reported that viewing the original painting was perceived by audiences to be of the highest value and was preferred by audiences. Lin [9] compared paintings displayed physically, with desktop VR, and with head-mounted display (HMD) VR and discovered that the audience response did not differ substantially for these different display methods. Unlike the static display of a painting, dance is dynamic. Kyan et al. used the cave virtual reality environment to visualize dance moves, then used the VR images to train ballet moves. The results of the study showed that even non-professional dancers participating in training for the first time can achieve a 96% accuracy of movements through the system [10]. It can be seen that the virtual image is helpful for expressing the details of dance movements. It is worth mentioning that The Dutch National Ballet launched the first VR ballet *Night fall* in 2016. The audience's senses escaped from the traditional auditorium, and they can even decide where to focus in the VR world. Hiskemuller pointed out that choreographer Peter Leung and his dancers had to throw out all their previous working methods and habits [11]; the choreography process is not only based on dance movements, but also guides the audience with audio in the space, so that the audience can go deeper into the scene, and the virtual image can be seen. Technology has also changed the way choreography was traditionally done. Further investigation and research are required to understand the differences between live and digital virtual dance performances as audience experiences of dance are changed by technology that transcends time and space.

This study used the 2020 reconstruction of the famous *Triadic Ballet* of the Bauhaus theater as a case study. The performance premiered in Germany in 1926 and was created by Bauhaus artist Oskar Schlemmer (1888–1943); it is now considered a representative work of contemporary art. It explored the concept of humans and spaces, presented the mathematics of body motion in space, and created a sense of three-dimensionality to the stage. Schlemmer sought a new form of stage through his experimentation with mechanical motions and abstract stages. Consequently, the *Triadic Ballet* has been praised as a prophetic movement of contemporary virtual stage spaces [12]. Thus, the *Triadic Ballet* was employed as a case study for investigating the properties of live and virtual performances.

1.1. Application of Virtual Images in the Performing Arts

The earliest performance with virtual images can be traced back to 1858, when scientist Henry Dircks (1806–1873) first proposed using projections for theater performances. Later, the Director of the Royal Polytechnic Institution, John Henry Pepper (1821–1900), created the projection technique Pepper's ghost, which was widely adopted in theaters [13]. Pepper's ghost was produced by using light and glass to reflect an object in a dark space to simulate a virtual ghost that could be interacted with by live performers. Although holographic technology has improved, Pepper's ghost is still a common technique, through reproduction and adaptation, to produce virtual images in museums, amusement parks, and theater stages [14]. In 2010, Japanese music software company Crypton Future Media developed a virtual female singer, Hatsune Miku. Pepper's ghost and holographic technology were used to produce a concert with a dynamic image of Hatsune Miku displayed on stage. Some members of participating audiences began to believe that she actually existed [15]. In a 2011 performance of *The Beauty and the Beast*, directed by Canadian directors Michel Lemieux and Victor Pilon, Pepper's ghost was used to create a virtual image of the young Beast on the stage to increase audience immersion in the performance [16]. In

the contemporary stage production *Urbik/Orbik*, created by French director Joris Mathieu, virtual images created with Pepper's ghost [17] were used to create a hybrid of real and virtual performances. Similarly, augmented reality (AR) and VR performances have also been produced. Israeli theater artist Sasha Kreindlin used AR technology in a children's show adaptation of *Gulliver's Travels* [18] to create an immersive experience for audiences. The Bauhaus Museum in Germany displayed a VR exhibition, *Das Totale Tanztheate* [19], to commemorate the museum's centennial; the exhibition was designed based on the theatric concepts of Schlemmer. The exhibition displayed virtual images created with a combination of VR and motion capture technology. Audiences wore HMD VR devices to create an immersive experience that caused them to feel like they were physically and emotionally present in the digitalized Bauhaus theater. Herscher et al. studied the feelings of audiences after they watched movies in the cinema or with a VR device [20]. They reported that, although VR devices could increase immersion and help audiences engage in the plot, the collective interaction of the audience with the movie plot in the cinemas could not be replicated by VR devices. Bender used psychophysiological methodologies, such as skin conductance level, facial electromyography, and other biometric responses, to measure the physiological responses of audiences watching VR movies. The results demonstrated that VR devices could increase audience excitement [21].

1.2. The Application of Digital Virtual Images in Dance

Digital technology is becoming increasingly common in modern life, and people are becoming more accepting of participation and interaction using digital technology. However, applications of digital technology in dance are still limited. Art such as movies, photography, and music rely on digital technology to some extent, but dance has remained analog because dance requires actual movements of the body. Postmodern dancer Loïe Fuller experimented with applying technology to dance by combining video projections and shadow effects to change her silhouette. She even created dance performances in which her costume glowed. Light rays have been manipulated to extend space and transcend the silhouette of dancers and their visual presentation [7]. *Light Plays* (1923) by Schlemmer combined human forms, shadow effects, and projections and was a pioneering explorative work of technological performance. During the 1920s, Schlemmer brought the abstraction of narrative, space, and dance to a pinnacle [22]. Multimedia performance company Troika Ranch developed software for dancers; the software could play and manipulate the captured live and prerecorded images in a dance performance. One of the lead developers of the software, Mark Coniglio, described the importance of "impossible instructions" to dancers and their experience with the instructions in the creation of new digital performances. Coniglio believed that current technology is insufficiently sensitive to human postures and the properties of human motion [23]. Rosenberg explained that the transfer of space and kinetic energy is becoming digitalized due to the development of multimedia technologies. Many types of dance performances have appeared, and applications of digital technology in dance have increased to include video dance, motion capture, VR, and network interactions [24].

While investigating applications of virtual dance images in the 1950s, American choreographer Alwin Nikolais (1912–1993) projected hand-painted slides onto the bodies of dancers on stage in an attempt to create a space where virtual images interacted with reality. Subsequently, numerous choreographers began attempting interactive projection [25]. The first three-dimensional documentary about dance, *Pina*, was directed by director Wim Wenders for the greatest dancer in the 20th century, Pina Bauch (1940–2009). Dances and body motions in movies are often enhanced or exaggerated through visual presentation techniques. Using a multidimensional lens can enhance the expression of body motions and the space of the stage [26]. Directors use three-dimensional images to connect audiences, who sit in front of the screen, with the theater presented in the movie to create the illusion of them being in a real theater, extending the theater out of the screen into reality. This change in perspective liberated audiences from remaining in a fixed location in the theater and

truly engaged audiences in the dance performance, which realized the idea of an extended theater [27]. The transition from the theater to the screen represents the interaction between real and virtual space; the border between the two becomes blurred, and screens and the Internet are becoming the new theater and creating new spectatorship [28]. Chin used moving screens as cues and used the interaction between screens and stages as an architecture for interpreting the unique phenomenon of contemporary spectatorship. Mobile technology has provided audiences with new methods of viewing performances and providing feedback [29]. Unlike conventional theaters, in which virtual text is viewed as a projection from another world, environmental simulations in contemporary VR break though the mimetic mindset of conventional art and form a self-sufficient world of their own. That is, the simulated world is no longer a replica or reference of the real world and has its own purposes [30].

1.3. Perceptions of Digital Audiences Viewing Dance

When the theater serves as an organism that mediates audiences and performances, the manner in which audiences view and perceive performances is affected by the format and medium of these performances. In conventional theaters, audiences are immersed and project themselves onto the fictional plot. Their minds become inseparable from the performance. After digital virtual technology was introduced to theaters, audiences began to use their sensations to experience the world that they perceived and imagined. A study [31] identified two types of immersion: Immersion in conventional theaters: although audiences in conventional theaters typically viewed performances passively, the extent of their immersion depended on whether they could actively enter the fictional alternative space and forget where they actually were. VR immersion: sensory-oriented VR digital theaters focus on materiality and physical sensations, breaking the boundaries between the "inside" and "outside" of the performance, enabling audiences to connect their internal and external sensory experiences.

Studies on theater audiences often focus on binary debates, such as virtual or real, prerecorded or live, or two- or three-dimensional. They frequently lament how the precious "liveness" of theaters is lost in videos [32]. Phelan argued that the life of performances was ephemeral, existing only in the moment. Performances could not be truly stored, recorded, documented, or redisplayed; these actions would convert a performance to something else [33]. Theater scholar Philip Auslander stated that the concept of liveness appeared after the emergence of video recording technology, that images displayed on screens also have the power to influence audiences, and that images and stages affect each other cyclically instead of cancelling each other out [34]. Sigrid Merx was optimistic about video recording and media usage and stated that these methods did not displace live performances [35]. Greg Giesekam reported that, since the start of the 20th century, both movies and stages have cooperated closely. Instead of destroying liveness, screens enhanced it [36]. Although the actual space and distance between performers and audiences increased, the spatial barrier was reduced due to interactive communication. Audiences also appear in the performance space and have importance equal to the performers. Moreover, audiences can share more of the experience than in a conventional performing environment because they are visible participants or performers themselves to some extent. Steve Dixon used three dimensions, namely, body, space, and time, to investigate changes in the performing arts and digital theaters and how the spatial perception of audiences was extended to create an immersive and dynamic theater set design. The special spatiotemporal perception of the set changed the perceptions of performers and of audiences. Conventional performing arts have been thought to require a collective response (for example, the audience looks in the same direction as a single entity). This concept is being consistently challenged by digital technology [7,22]. During the digitalization of performances, the viewing behaviors of audiences have been reexamined in terms of the viewing experiences of individuals. Audiences are encouraged to become a part of an art performance. In technological theatric performances, the perspective of an "experiential experience" was taken to focus on how

audiences imagine and reflect on the purpose of artworks and how interactions occur between multiple texts [37].

1.4. Purpose

Performing arts have a characteristic liveness. Scholars have debated whether the COVID-19 pandemic has changed the lifestyles of audiences and their performance viewing habits and have yet to reach a conclusion. Online videos and virtual dances provided by dance troupes have given audiences a novel perspective for viewing performances and, with the advent of the metaverse, have accelerated the development of virtual technology in dance. Studies have investigated how audiences viewed performances with various media in museum exhibitions, painting exhibitions, and cinemas. However, little research has been conducted on dance performances experienced through different media formats. Studies have investigated the perception of audiences viewing digital dance performances; however, these studies were subjective. Therefore, this study investigated which of the following formats best enhanced audiences' resonance with or perception of dance performances: live performances, screen images, and virtual images. Moreover, some suggestions for creators of screen image dances and virtual image dances are provided.

2. Materials and Methods

2.1. The Dance Work

The research sample consisted of audiences of the renowned dynamic art performance, the *Triadic Ballet*, of the Bauhaus theater, which was reproduced by our research team (see Figure 1) [38]. The *Triadic Ballet* premiered in 1922 and was created by Schlemmer [39]. The *Triadic Ballet* is the most famous work of Bauhaus artist Schlemmer. Its performance in color, shape, and space is quite modernist. Our team reconstructed this work, using the manuscripts and diaries left by Schlemmer to create costumes and movement, and promoted this work to a senior high school and a University for performances in art education promotion activities (see Figure 2). A total of 334 students appreciated this work, the average score of preference for the work is 4.18 points (out of 5 points), which shows that, even after 100 years, this work is still accepted by modern audiences. The ballet was an experiment on the relationship between the human body and space. The rigid and mechanical dance motions of the actors in costumes and masks challenged perceptions of the integration between modern technology and dance performances and stimulated reflection on the coexistence between reality and virtuality [40]. Schlemmer once said that the emergence of new forms of theaters is just a matter of time, technology, and materials [41]. Therefore, the *Triadic Ballet* was used to investigate how the audience felt when they viewed live performances, screen images, and virtual images. The dance performance was divided into three acts named *Yellow*, *Rose*, and *Black*. The duration of each act was approximately 1 min and 20 s. The total duration of the performance, including intermissions, was 5 min.



Figure 1. Reproduction of the *Triadic Ballet*. (Source: Reprinted with permission from [34]. Copyright 2011 Ting, I.-W. et al.).



Figure 2. *Triadic Ballet* educational promotion and performance activities. (Source: this study).

2.2. Participants

In order to gain a deeper understanding of the differences in different performance forms, this study selected college students with artistic backgrounds to participate in this experiment, in order to reduce the general audience's cognitive difference of artistic works. A total of 30 art university students participated in the experiment: 8 were men (26.7%) and 22 were women (73.3%). Their average age was 20.2 years (SD = 0.817). The average self-evaluation scores of the participants for their understanding of Bauhaus and Bauhaus theater were 3.3 and 2.9, respectively (1 indicated that the participant knew little about Bauhaus, and 5 indicated a comprehensive understanding). Overall, fifteen participants reported preferring live performances (50%), thirteen preferred virtual images (43.3%), and two preferred screen images (6.7%).

2.3. Experimental Design

2.3.1. Independent Variables

The independent variable in the experiment was the format of the *Triadic Ballet*: live performance on stage, screen images, and virtual images.

The formats are as follows:

- Live performance. The live performance was performed on the stage of a professional theater. On the day before the experiment, lighting, flooring, and audio were installed. A colorful background was projected on the cyclorama with a 6000-lumen laser projector (PT-MZ670A; Panasonic, China); the dancers performed a full rehearsal on the stage. On the day of the experiment, the dancers performed the three solo dance acts: first *Yellow*, second *Rose*, and third *Black* (see Figure 3).

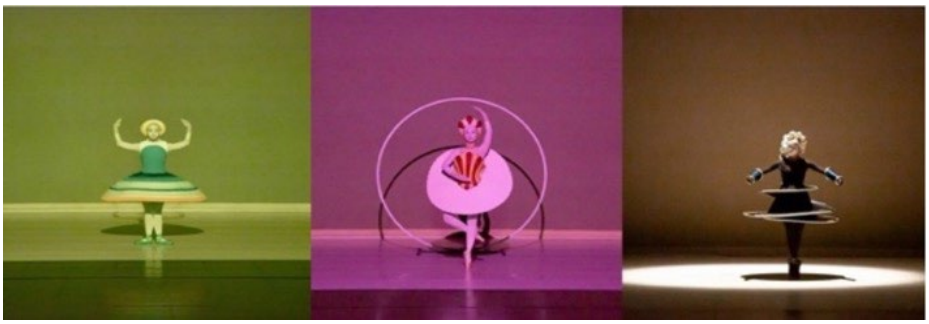


Figure 3. Live performance. (Source: this study).

- Screen images. To produce the screen images, the dances were filmed and recorded in a virtual studio. Motion was also filmed and captured in front of a green screen for constant-color matting. After the images were recorded, the image editing software Adobe After Effects was used for image matting. The final images were displayed using a 36-inch vertical television (TL-32LE60; Chimei, Taiwan) (see Figure 4).



Figure 4. Screen performance. (Source: this study).

- Virtual image. The virtual images were created in our previous study [34]. Images based on Pepper's ghost were used because it was the first method of producing virtual images in theatric performances to enable interactions between live performers and virtual ghosts (see Figure 5). In order to reduce the blue light generated by the glass projection, when making the projection black box, the background color of each dance was painted in the black box, the dance video adopted the image of removing the back, and small lamps with an adjustable light source were used to adjust the display black box according to the intensity of the on-site light at the exhibition site light source to present the most suitable brightness for viewing.

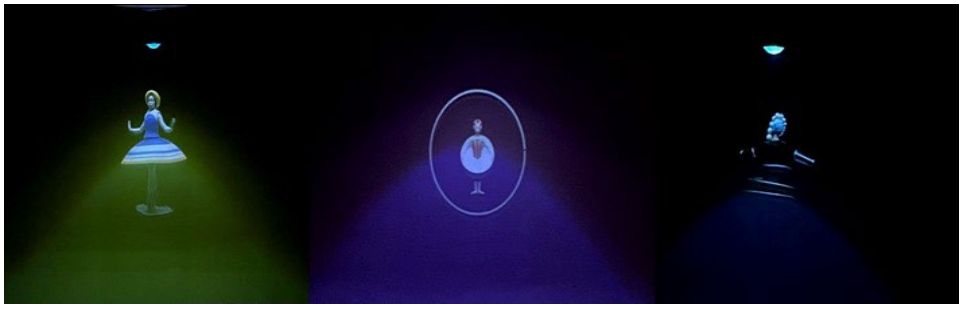


Figure 5. Virtual performance. (Source: this study).

2.3.2. Dependent Variables

The dependent variables of this study were the participants' perceptions of a performance (see Table 1), as indicated by the results of a questionnaire survey. Participants first rated the dance performance content, including route and trajectory, movements and expressions, costumes, and overall atmosphere. Second, they rated the dance performance space (depth, width, height), including dance movements, overall costume styles, and overall dance style. Third, the participants selected their favorite dance and format.

2.4. Research Hypothesis

According to the purpose of this study, the research hypotheses are as follows: 1. The dance performance content has significant differences in different forms of expression. 2. There is no significant correlation between the dance performance content. 3. The dance performance space has significant differences in different forms of performance. 4. There is no significant correlation with the dance performance space.

Table 1. Questionnaire of dependent variables.

Part		Item
Part 1	dance performance content	1. route and trajectory 2. movements and expressions 3. costumes 4. overall atmosphere
Part 2	dance performance space (depth, width, height)	1. dance movements 2. overall costume style 3. overall dance style
Part 3	favorite dance	1. *yellow* 2. *rose* 3. *black*
	favorite format	1. live dance 2. screen dance 3. virtual dance

Source: this study.

2.5. Experiment Procedure

The experimental procedure was divided into three stages. The first stage was the preparation stage, in which the researchers explained the purpose and procedure of the experiment to the subjects. The second stage was the experiment. The participants viewed the different formats of the performance in a random order in accordance with instructions from the administrators. They viewed a live performance, a televised performance, and a virtual performance (see Figure 6). In order to avoid the problems of viewing fatigue and learning effect among the 30 subjects in this study, as well as to avoid the unpredictable situation of the stage and dancers during the live performance, which could cause confounding variables, the subjects were randomly assigned. There were six groups with five people in each group, and the start time and viewing form order of each group were adjusted so that each group watched the live performance at the same time; the detailed grouping is shown in Table 2.



Figure 6. The viewing situation of live dance, virtual dance, and screen dance. (Source: this study).

The participants did not wear VR devices, to avoid the experience of wearing an HMD affecting their feedback. After viewing the performances, they completed a questionnaire for that format and returned it to an administrator. The participants were not required to complete the questionnaire within a specific time. In the third stage, the participants returned their folders with completed questionnaires and the number tags used for the experiment. Finally, they provided demographic data and reported their overall viewing experience on the final questionnaire.

Table 2. Audience grouping order.

Group	Group	1	2	3	4	5	6
	Number	**1–5**	**6–10**	**11–15**	**16–20**	**21–25**	**26–30**
Time	10:40			3			1
	10:50	1			3		
	11:00			1			3
	11:20	2	2	2	2	2	2
	11:30	3				1	
	11:40		3		1		
	11:50		1			3	
Viewing form: 1 = Screen dance, 2 = Live dance, 3 = Virtual dance							

3. Results

3.1. Format and Dance Content Perceptions

The goal of this study was to understand whether perceptions of dance content were affected by dance format. The ANOVA analysis reveals that format did not significantly affect perceptions of dance content for any of the questionnaire elements. Although the differences were nonsignificant, the average scores for the live performances were strictly greater than those for the screen or virtual performances; except for screen images presented for *Black*, the average scores of route and trajectory, costume color are greater than other formats. Therefore, bright-colored costumes were preferred in virtual images and black costumes were preferred in screen images.

3.2. Correlations between Dance Content Items

A correlation analysis was used to further investigate the relationships between dance choreography, movements, costume colors, and overall atmosphere (see Tables 3–5). Significant and positive correlations were observed in *Yellow* for witty movements and expressions with a humorous dance atmosphere and in *Rose* for stern movements and expressions with a humorous dance atmosphere. Hence, both choreography and atmosphere affect audiences' perceptions of dance.

Table 3. Correlation analysis: *Yellow*.

	Item	1	2	3	4
yellow	1. Rectangular route and trajectory	-			
	2. Witty movements and expressions	0.445 **	-		
	3. Splendid costume colors	0.236 *	0.338 **	-	
	4. Humorous dance atmosphere	0.298 **	0.739 **	0.302 **	-

* $p < 0.05$, ** $p < 0.01$.

Table 4. Correlation analysis: *Rose*.

	Item	1	2	3	4
rose	1. Triangular route and trajectory	-			
	2. Stern movements and expressions	0.558 **	-		
	3. Grand costume colors	0.409 **	0.577 **	-	
	4. Solemn dance atmosphere	0.450 **	0.685 **	0.678 **	-

** $p < 0.01$.

Table 5. Correlation analysis: *Black*.

Item		1	2	3	4
black	1. Circular route and trajectory	-			
	2. Magical movements and expressions	0.429 **	-		
	3. Steady costume colors	0.290 **	0.231 *	-	
	4. Mysterious dance atmosphere	0.313 **	0.342 **	0.463 **	-

* $p < 0.05$, ** $p < 0.01$.

3.3. Format and Dance Space Perceptions

The results in Table 6 demonstrate that the spatial width of dance movements, the spatial width of the overall costume style, and overall spatial depth were significantly greater for the live performance than for the other formats. Overall, the average scores for dance movement and overall costume style were highest for live performances and lowest for screen images, which were attributed to the limited visual areas of the screens, reducing audience perceptions of the spatial width of movements and styles. Moreover, the spatial depth scores were highest for virtual images and lowest for screen images.

Table 6. ANOVA analysis of expression of space.

Subjective Questionnaire (1–5 Points)	Format			
	Live Performance	Screen Image	Virtual Image	Sig.
1. The dance movements had changes in the spatial depth	4.33	3.83	4.10	
2. The dance movements had changes in the spatial width	4.17	3.47	3.77	**
3. The dance movements had changes in the spatial height	3.47	2.87	3.13	
4.The overall costume style presented spatial depth	3.80	3.73	3.97	
5. The overall costume style presented spatial width	4.07	3.53	3.80	**
6. The overall costume style presented spatial height	3.53	3.33	3.30	
7. The overall dance presented spatial depth	4.23	3.73	4.30	**
8. The overall dance presented spatial width	4.23	3.63	3.90	
9. The overall dance presented spatial height	3.47	3.07	3.20	

** $p < 0.01$.

Audience perceptions of depth may differ depending on their distances from the performances; audiences in the virtual space may have been able to better observe changes in the depth of the dance movements than some live audience members.

3.4. Correlations between Spatial Expression Items

Table 7 reveals that all nine spatial expression factors were significantly correlated. Therefore, although space is an abstract concept, dance movements and costume styles that effectively express space result in an effective expression of space in the overall dance, reinforcing audience perceptions.

Table 7. The correlation analysis of the items of the expression of space.

Variable	1	2	3	4	5	6	7	8	9
1. The dance movements had changes in spatial depth	-								
2. The dance movements had changes in spatial width	0.582 **	-							
3. The dance movements had changes in spatial height	0.425 **	0.622 **	-						
4. The overall costume style presented spatial depth	0.550 **	0.337 **	0.396 **	-					
5. The overall costume style presented spatial width	0.355 **	0.578 **	0.392 **	0.385 **	-				

Table 7. *Cont.*

Variable	1	2	3	4	5	6	7	8	9
6. The overall costume style presented spatial height	0.282 **	0.480 **	0.611 **	0.397 **	0.587 **	-			
7. The overall dance presented spatial depth	0.590 **	0.405 **	0.276 **	0.513 **	0.408 **	0.245 *	-		
8. The overall dance presented spatial width	0.387 **	0.616 **	0.498 **	0.371 **	0.621 **	0.522 **	0.565 **	-	
9. The overall dance presented spatial height	0.272 **	0.465 **	0.700 **	0.273 **	0.436 **	0.640 **	0.264 *	0.679 **	-

* $p < 0.05$, ** $p < 0.01$.

3.5. Favorite Dance

The chi-squared test was used to investigate audience preferences for the three dance performances in various formats (see Table 8).

Table 8. Chi-squared test for favorite dance.

Independent Variable			Items			χ^2	df
			yellow	*rose*	*black*		
Format	Live performance (n = 30)	f	10	7	13	1.8	2
		%	28.6	25.0	46.4		
	Screen image (n = 30)	f	14	7	9	2.6	2
		%	48.4	22.6	29.0		
	Virtual image (n = 30)	f	11	4	15	6.2 *	2
		%	36.7	13.3	50.0		

* $p < 0.05$.

Virtual and live viewers both preferred the *Black* dance, whereas screen viewers preferred the *Yellow* dance. *Rose* was the lowest-rated for all formats. These results indicate that virtual images may enhance the "mysterious" atmosphere of the *Black* dance for audiences, and bright colors may be preferable for screen viewers.

4. Discussion

In this study, the audience perceptions of the *Triadic Ballet*, a Bauhaus theater performance, in various formats, namely, live performances, virtual images, and screen images, were investigated. The research results suggest the following conclusions.

4.1. Superiority of Live Performance

The *Triadic Ballet* was a spatial interpretation experiment by Schlemmer. Through dance performances, the trajectory of the human body, costumes, and spatial colors can be observed. The results indicate that audiences prefer the *Triadic Ballet* as a live performance. Spatial width perceptions of the items "dance movement," "overall style," and "overall stage" were greater for live performances than for on-screen or virtual performances.

4.2. Modern Technology as an Alternative to Different Formats of Performances

Modern technology has enabled audiences to view performing arts in diverse formats and perspectives, including conventional screen images and virtual, 3D images. In this study, the Pepper's ghost effect was used to create a simple virtual image device for displaying the *Triadic Ballet*. Audiences gave the highest ratings for depth to this virtual performance, indicating simple virtual devices could be superior to live and on-screen performances for certain spatial perceptions of *Triadic Ballet* audiences.

4.3. Differences in Viewing Media

In art appreciation, audience ratings and preferences differing between performances are normal. These preferences could also differ for the same performance presented using different media. This study performed a correspondence analysis for the three dance performances and the three formats: live performance and virtual image audiences rated the third performance *Black* the highest, whereas screen audiences preferred and rated the first performance *Yellow* the highest. The intention of Schlemmer (to interpret space) was best achieved by live performances and virtual images; however, screens could be used for specific units of the performance.

4.4. Blending Cognition and Emotion

Bauhaus has long been studied due to its impact on contemporary design, but Bauhaus theater, particularly the *Triadic Ballet* of Schlemmer, is often overlooked and is rarely discussed. The study participants knew little about Bauhaus; however, their ratings of choreography, movement and expression, costume color, and dance atmosphere were highly correlated, and the dance movement, overall style, and overall dance were significantly correlated in terms of spatial expression. These results demonstrate that, if creators adequately arrange and present their creative concepts, audience cognition and appreciation of the performance can be improved.

4.5. Audience Perceptions of Different Media Representations

From the literature, we can see that many discussions on the application of virtual technology in performances mostly focus on how the characters can be displayed through virtual technology, so that the audience can go deeper into the scene and integrate into the development of the plot. The audiences in this study analyzed the differences in viewing cognition through the non-dramatic performance of the *Triadic Ballet*, and we integrated the literature analysis and the results of this study. In addition to enhancing the audience's deep feeling of the plot, virtual image technology can also be used in Minimal Art, increasing the audience's display of dance movements and the overall performance in its details. The audience members' interaction with other members of the audience in the real theater, and the emotions reflected by the audience following the dancers' performance, such as tension, excitement, and joy and sorrow, are the advantages of live performances, which cannot be achieved or replaced by other technologies.

5. Conclusions and Suggestions

5.1. Conclusions

Performing arts have been discussing the issue of live performances for a long time, However, with the development of virtual technology and the rise of the metaverse, the viewing logic of audiences watching live performances has also changed; how to convey the characteristics of dance works through appropriate performance forms helps the audience obtain a good viewing experience. This study verifies the effects of different performance forms through appropriate research and understands the characteristics and differences of live performances, screen images, and virtual images. Among the three forms, the sense of space in live performances cannot be replaced by other imaging technologies; however, with virtual images, the excellent performance in the depth of space helps to solve the problem of the viewing distance between the audience and the stage in real theaters. Although the frame of the screen image limits the audience's perception of space, better color perception is achieved with the screen image. The results of this study provide a reference for choreographers when designing the expression form of works in the future and help to enhance the audience's viewing experience and cognition of the work. How to display the sense of space created by real dancers through movement performance and costume modeling in virtual images and screen images is also worthy of further development of related technologies.

It is worth mentioning that, as virtual technology becomes more mature, audiences will have more choices in the way they watch dances in the future. Therefore, when artists create dance works, should art precede technology or technology precede art? How to maintain the uniqueness of artistic creation will be an issue worthy of in-depth discussion in the future. According to the results of this study, when the dance company displays dance works on the Internet or other media, it is no longer applicable to directly use the video records of stage performances in the past. When presenting dance works in different media in the future, the characteristics of the display media should be considered. If choreographers focus on the details of dance works, using virtual image display can be considered. If choreographers focus on the color design and stage design works, screen displays can be used. If choreographers focus on the relationship between dancers and space in dance works, it is still recommended to use live performances on the stage. Only by making good use of the characteristics of different display forms can the characteristics of the work be properly presented to the audience, so as to improve the audience's cognition of the work and its viewing experience.

5.2. Suggestions

This study has a few limitations. First, the modern performance of the *Triadic Ballet* was used; the cognition and understanding of audiences could differ for other dance styles. Second, the research subjects were art university students, and the results may not be applicable to general audiences. Third, the small sample size of 30 participants may be insufficient to draw general conclusions.

A Pepper's ghost effect was used to produce the virtual dance performances in this study; however, various virtual images can now be created with modern technology. As digital technology advances, it increasingly affects the display of the performing arts. A century ago, Schlemmer used the prospective performance of the *Triadic Ballet* of the Bauhaus theater to predict the future of performing arts. Interdisciplinary cooperation between technology and art can inspire new forms of creative expressions and expand the study of art and technology.

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