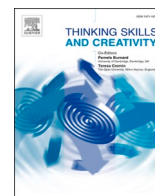




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Dance in Zoom: Using video conferencing tools to develop students' 4C skills and self-efficacy during COVID-19

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ABSTRACT

During the COVID-19 pandemic, the education community has actively sought strategies to allow it to maintain operations; one such strategy is to switch from face-to-face to online teaching. Compared with other art disciplines, the use of technology in dance education has been seriously understudied. This study collected multiple forms of data, tapping into students' and instructors' viewpoints, to examine the use of Zoom to develop students' 4C skills (i.e., creativity, communication, collaboration, and critical thinking) and self-efficacy in dance education. A mixed-methods research design was adopted. Teacher observations and student surveys were conducted in a public university in Macau. The results showed significant increases in collaboration and creativity in the activities and assignments on Zoom. Critical thinking and communication skills did not change significantly in the Zoom-based dance class. Students were generally satisfied with the use of Zoom in dance class, but their self-reported self-efficacy significantly decreased after Zoom was introduced. The findings are discussed from both the students' and the instructor's perspectives.

1. Introduction

In early 2020, the World Health Organization (WHO) assessed COVID-19 as a global public health emergency of international concern, as well as declaring it to be a pandemic (Cucinotta & Vanelli, 2020). In response to COVID-19, many schools and educational institutions around the globe ceased face-to-face teaching. The education community has been actively exploring different strategies and seeking alternative ways to continue working. Many tertiary institutions have been forced to halt face-to-face courses and move to some type of remote or online learning (Hodges et al., 2020). Research into the use of technology in teaching/learning during the pandemic has been conducted in disciplines such as visual arts (Tetikci et al., 2021), media arts (Zuhairi et al., 2021), music (Kladder, 2021), and drama (Wang, 2021). However, dance education and the use of digital technology in this discipline has been seriously understudied (Li et al., 2018). The pandemic has caused a surge in dance scholarship about the use of technologies for online teaching (Li, 2020, 2021) and as virtual dance workshops for teachers (Schmid & McGreevy-Nicholas, 2021). Research is warranted in investigating not only how dance teaching has been conducted, but also how students continued on their learning journeys during the pandemic.

Traditionally, dance education has tended to overemphasize technique (Hopper, 2002), ignoring individual differences in students and leading to varied levels of student proficiency and uneven development (Zhang, 2019). Focusing solely on moves and techniques

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inevitably sacrifices opportunities to develop the other skills needed for a person's growth. Empirical research has shown that dance educators can support students in becoming self-directed (Crockett, 2020), socially competent (Petrie, 2020), and critical thinkers (Leijen et al., 2009). This suggests that knowledge (i.e., an awareness of the diverse traditions, histories, and cultures of dance) and skills (i.e., the ability to perform or choreograph a dance) are not the only important outcomes we want to achieve. The goals outlined by the *Partnership for 21st Century Skills (2009)* (P21), which articulated the 4C skills (i.e., critical thinking, communication, collaboration, and creativity), are thus worth assessing (Stinson, 2012).

The U.S. National Dance Education Organization (NDEO) states that the goal of dance in higher education is to function proactively, articulate and substantiate potentially radical innovation for dance in higher education, and foster the leadership required to forge structural change (Kolcio, 2013). The current efforts to borrow and adapt models of dance education from countries such as the U.S., which aims to educate well-rounded individuals while teaching dance (Farrer, 2014), have prompted colleges and universities in China to begin setting out their own dance teaching goals by combining dance technique and whole-person development (Gong, 2019). The NDEO approach is based on a holistic view of learners (Spector & Park, 2018), who possess an integrated set of cognitive, physical, and affective attributes which are interrelated and interact over time (Spector et al., 2019). The processes of globalization have caused contemporary perceptions and practices of dance to become more internationalized (Heyang & Martin, 2021), and more and more dance educators have realized that dance education is a pedagogy for empowerment, not just hopping and swirling (Gonzales, 2019).

Although China has a rich history of dance education, the use of online tools in dance education is still a new trend, and insufficient research has been conducted in investigating the effectiveness of teaching dance online (You, 2020). In some ways, digital tools can push dance education to an unknown territory—a space where technology, creativity, and embodiment intertwine (Schmid & McGreevy-Nicholas, 2021, Li et al., 2022). As such, this study attempted to consolidate this view by examining how technology was used during the pandemic in an undergraduate course named *Introduction to Dance Studies*, in Macau SAR, China, and how this practice helped students develop their 4C skills. Macau shares similar values and pedagogies with other Chinese dance programs. However, Macau has been in the lead over other cities in China in the innovation of using technology in the dance classroom with the addition of a global perspective of what dance education can and should deliver. During the pandemic, Macau was also one of the first few cities in China to switch from face-to-face to online teaching in dance classrooms. It is also the first place in China where online dance research was conducted (Li, 2020). By adopting a holistic model of dance education, in which the distinctive features of students as human beings are considered, we can examine the competencies of dance students. This allows us to validate the role played by online tools in dance education in a Chinese context and to explore the way digital technology can be used to optimize student learning and development. The findings of this study greatly enrich our understanding the use of digital technology in dance education in China from pedagogical and practical perspectives.

2. Literature review

Globalization has changed all aspects of our life and society, including education. In this new era, education must develop the capacities people need for life in the 21st century; this reality is addressed by the P21 goals and the 4C skills, including the ability to think critically, communicate effectively with different people, innovate, and solve problems through negotiation and collaboration (Saavedra & Opfer, 2012). As Miller (2000) asserted, a whole person consists of, but is not limited to, intellectual, emotional, physical, social, aesthetic, creative, and spiritual elements. In this sense, dance students are not trained bodies anymore but are live people finding artistic identity and voice. Holistic education is an approach to pedagogy in dance education that can meet the goal of developing the above aspects in learners by recognizing future dancers as physical, emotional, and intellectual beings. As Sööt and Viskus (2014) argued, holistic dance teaching takes the distinctive features of students as human beings into account. It exhibits a commitment to holism in all of its facets: in program, curriculum and course design, lessons, and individual learning activities. It is beyond doubt that, from a holistic perspective, educating a dancer requires drawing on and strengthening multiple elements throughout the learning process.

2.1. 4C skills in dance education

Students' self-regulation, critical thinking, creativity, and collaboration have become increasingly important in today's dance education (Amado et al., 2017; Sugiarto & Lestari, 2020). As asserted by the *President's Committee on the Arts and the Humanities (2011)* in the U.S., the performing arts facilitate the development of 21st century skills. These skills include "critical and creative thinking," "dealing with ambiguity and complexity," "development of social competencies, including collaboration and teamwork skills, social tolerance, and self-confidence," "integration of multiple skills sets," "problem solving," and "transfer of skills learning from the arts to learning in other academic areas." Dance has a wealth of resources that support learning within its evolving pedagogy and scholarship (Kassing, 2010), and can be taught in a way that cultivates and encourages these skills in students to allow for experiences that "act as a conduit to teaching originality, self-motivation, resiliency, and flexibility" (Mercer, 2018a, p. 1).

Moffett (2012) explored the role of critical thinking through movement, arguing that strategically constructed dance classes in improvisation and choreography could promote critical thinking skills. Similar work was done by Kane (2013) and Henley (2014). These skills were associated with creativity, collaboration, and problem solving (Cameron Frichtel, 2017). In semi-structured interviews with five practicing teachers at a higher education institution for contemporary dance, Clements and Redding (2020) found that dance teachers understood creativity as being evident in the process rather than the product and identified creativity as more likely in students who were confident, open, and intelligent. Reed & Weber (2017) also interviewed three dance educators on developing creativity in dance class. A breadth and multi-directionality of thought, a sensitized relationship to embodiment, and

practice were found to contribute to enhancing students' creativity.

A review of the above studies revealed several issues. First, with the exception of a study by Gradwohl (2018), who tried to understand the advantages and disadvantages of using technology in dance classrooms to cultivate creativity, critical thinking, and collaboration skills, no study examined the whole set of 4C skills in dance education. However, Gradwohl (2018) evaluated dance educators' perceptions of technology integration but not those of students. The lack of learners' views on this matter masked the true effectiveness of cultivating these skills with modern technology. Second, few studies investigated the promotion of 4C skills within a technology-based learning environment (e.g., Mercer, 2018b). You (2020) conducted an online survey to understand the impact of e-learning on dance education among Chinese university students. Students were found to be positive about the effect of e-learning and their communication competence was greatly developed (compared with their technical skills and theoretical knowledge). Furthermore, the use of technology was found to enhance students' creative process because these platforms allowed the students to critically reflect on and evaluate the details in their compositions. Last, it appeared that qualitative approaches such as interviews dominated the way the cultivation of 4C skills in dance education was examined. Although qualitative approaches offer a range of insights into the ongoing discussion, the use of mixed-methods designs presents alternative and supplementary perspectives (Creswell & Piano, 2007).

2.2. Self-efficacy in dance education

The construct of self-efficacy, introduced by Bandura (1977), is understood as one's self-belief or personal judgment about one's own competencies. It is primarily a cognitive appraisal of one's capabilities to perform a prospective task or to reach a pre-defined standard (Choi, 2005). In the educational context, students' self-efficacy is believed to influence the choice of tasks, the level of task performance, the amount of effort put into performing the chosen tasks, and the degree of perseverance in task performance (You, 2018). It has been found to be the strongest predictor of academic performance in tertiary education in two meta-analyses (i.e., Richardson et al., 2012; Robbins et al., 2004).

RCampus (2014) proposed that self-efficacy could be another critical index in the criteria for rating dance education. When students possess strong self-efficacy, they tend to give full play to their potential (Sööt & Leijen, 2012) and set better goals for learning and practicing dance (Kane et al., 2013). As Burgess & others (2006) reported, dance had a positive effect on self-image and self-perceptions, which subsequently influenced the development of adequate self-esteem. Therefore, dance education can be expected to increase self-esteem and bring about positive changes in the body and mind. Indeed, with a sample of middle-school girls in Korea, Oh et al. (2018) observed that students' self-efficacy was significantly improved by their greater awareness of their bodies in dance lessons. Real-Torres et al. (2020) also reported that university dance students scored higher in self-efficacy than those who did not take dance.

2.3. Technology-enhanced dance education during COVID-19

For decades, dance as a practice-based subject has been taught in studios and in face-to-face settings. As one of the oldest forms of performing arts, dance has been reluctant to embrace modern technology, firmly believing that it has to be taught in a bricks-and-mortar setting (Morris, 2018), even as evidence mounts of the benefits of using technology in dance education (Hsia & Sung, 2020). With the majority of students nowadays growing up with the latest digital technologies, researchers have promoted the benefits of using technology in dance education (Zhou & Li, 2019; Li, 2020; Hsia & Sung, 2020). Studies have provided sufficient evidence to prove that the utilization of various technologies (e.g., mobile, VR, AR, blogs, apps) in the dance classroom enhances teaching efficiency (Ren, 2017) and student engagement (Huddy, 2017) and enriches teaching resources (Gingrasso, 2019) and interactions between instructors and learners (Naidoo & Kopung, 2016). Zoom has been used in various disciplines at universities due to its quality audio, video, screen sharing and well-supported interactivity (Parkinson, 2018). This makes it a top choice for online lectures and meetings, webinars, virtual conferences, and more (Serhan, 2020).

Teaching dance virtually through Zoom embraces new pedagogical philosophies and approaches. It is fortunate that today's young adults are accustomed to using digital devices to attend classes and complete learning activities (Warden et al., 2020; Li, 2021). Zoom-based dance classes make students more aware of limitations (time and space constraints) and responsibilities (roles and actions) compared to face-to-face classrooms, as participants share a screen with the instructor. Students must express themselves clearly (communication), hold each other accountable (collaboration), review, debate, and make selective revisions (critical thinking and creativity). This leads to a strong sense of inter-dependency and ownership among group members. Although online dance education lessens concerns about geographical, physical, and financial differences (Escobar Varela & Hernández-Barraza, 2020) as well as enhancing flexibility and permitting individualized learning paces (You, 2020), space and privacy emerge as concerns for both instructors and students.

2.4. The present study

The COVID-19 pandemic pushed all the courses in University of Macau switched to online teaching mode. In the general education course "Visual and Performing Arts—Introduction to Dance Studies," Zoom was adopted due to its proven effectiveness in tertiary teaching (Rixon et al., 2021) and students' increased satisfaction with the course (Lee, 2021; Sayem et al., 2017). Many of the studies of online learning systems in dance classes have focused on the design or the proposal of effective dance learning systems for students, such as using Microsoft Kinect (Baek & Kim, 2015) or gamified Virtual Reality (Senecal et al., 2020), rather than investigating how such designs contribute to the various aspects of students' development. Given students' readiness to apply digital learning to dance

(Li, 2020), Zoom's features, and the pandemic, this study examined how students' 4C skills and self-efficacy were affected by virtual dance classes and whether this could become a new way of teaching dance in the post-pandemic era.

Specifically, the following three research questions guided our study.

- (1) Did the use of Zoom in dance class affect university students' development of 4C skills? If so, in what way?
- (2) Did the use of Zoom in dance class affect university students' self-efficacy? If so, in what way?
- (3) Did the use of Zoom in dance class affect university students' satisfaction with the class? If so, in what way?

In this study, we adopted a mixed-methods approach to help us better understand the phenomenon under study (Warfa, 2016) by collecting both qualitative (the instructor's observations and students' feedback from open-ended questions) and quantitative (Likert-type survey questions) data. Although quantitative methods can provide empirical evidence, they lack the in-depth details and descriptive clarity that can be achieved through qualitative methods (Onwuegbuzie & Leech, 2005). A qualitative follow-up investigation is thus frequently used to provide complementary information and interpretation in understanding students' online learning outcomes (Marboot et al., 2020). Further, the combination of qualitative and quantitative data can ensure the validity of the study and these multiple data sources can contribute to data triangulation (Tashakkori & Teddlie, 2009). Following this approach, qualitative techniques were used to explore both students' and instructors' views on the use of Zoom in their dance classroom, and to provide contextual information about the students' experience. The quantitative findings were used to obtain empirical evidence showing the effects of using Zoom.

3. Method

3.1. Participants and settings

A convenience sampling approach was used. Students from a "Visual and Performing Arts—Introduction to Dance Studies" class were invited to participate in this study. No reward or incentive was offered. An online questionnaire was distributed by the course instructor to the students at both the outset and the end of the course. Informed consent was sought before the questionnaire was completed and all the participants were clearly informed of the purpose, nature, and procedures of the research. Meanwhile, the instructor logged his observations while teaching on Zoom throughout the semester. Of the 92 participants, 16 students who did not complete the pre- and post-tests were excluded. Seventy-six students provided complete data for both tests. Three outliers were detected and removed from the dataset, leading to a final sample of 73 participants. Overall, the majority of the students were beginners with limited exposure to dance, compared to approximately 20% with extensive dance backgrounds.

This dance course was an elective general education course, with a focus on artistic expression and individuality, as opposed to technical proficiency. Reviewing dance teaching/learning practices in this context offered at least two benefits. First, as there are many more universities and colleges offering non-compulsory elective dance courses than there are elite performing arts conservatoires, the insights and practical strategies from our study could be applied to many other similar programs elsewhere in the world. Second, non-compulsory dance courses are not usually skill-oriented, and students who enroll in this type of course come from mixed academic and dance backgrounds. Hence, it is extremely valuable and interesting to study how non-professional dance students develop their 4C skills on top of the necessary dance techniques.

Each dance class was divided into theory and practice parts. In the practice part, students followed the dance instructor carrying out various physical exercises, while all the material related to theories of dance were covered in the theory part. Students either worked individually or in small groups. As this course was intended to develop 4C skills on top of the necessary dance techniques, both the practice and theory segments contained a series of tasks that aimed to foster 4C skills and self-efficacy among learners by the use of different Zoom features. For example, in one practice task, the students had to extend a movement sequence of 2×8 bars to 4×8 ; they



Fig. 1. Screenshot of using Zoom in dance class.

were expected to learn the sequence, practice it, and then reflect on this combination. Then they were asked to create extra movements for the beginning, middle, or the end. They could communicate in the chat room on Zoom or observe online what others were doing. Seeing one or two people from one direction tends to simplify a dancer's relationship to space and others when working in a studio setting. In Zoom settings, however, all the dancers (about 50 per Zoom page) moved together in the same virtual space (see Fig. 1), creating the illusion that each student was being closely monitored by the instructor. Students worked harder as a result. Meanwhile, students could also be inspired by seeing how their peers jumped, turned, or paused with eye-catching tableaux. Students were motivated and inspired by each other during this process, with a clear goal of creating an intriguing piece of choreography. Critical thinking was expected to be triggered about what to absorb and how to put the movements together in an innovative way.

Digital technology resolved restrictions in distance, space, and time in virtual dance classes to different extents. In particular, students frequently used chat rooms to exchange ideas while the instructor simultaneously monitored the discussion. For those students who might feel shy or nervous about speaking out in public, text/written contributions were allowed to make them feel more at ease. Breakout rooms were also created to develop work in small, collaborative groups, making every member accountable for a given task. Each breakout group consisted of three to five students. Other students could not drop into other groups, but the instructor could drop into any group and participate in the discussions. While encouraging and monitoring student discussion in the breakout rooms, class observations also took place in the virtual environment during the instructor's visit. The instructor was then able to collect evidence of learning, monitor students' progress, facilitate discussions, and promote student engagement. The use of breakout rooms was expected to be an effective approach to facilitate teaching and help students develop 4C skills.

Screen-sharing was used to feature all kinds of student work, as well as work of established dance artists and to share online resources. Students could also receive feedback from both the instructor and their peers. Screen recording was also available in each class to record peers' performances and/or the course content for reference or review. During the pandemic, a familiar dance space (e.g., the studio) was no longer available, but a wide variety of other spaces could be used in innovative and beneficial ways, particularly in asynchronous classes. Students could step out of their comfort zones and record their creative work in parks, on rooftops, and even underwater. This was a huge incentive to be more creative. In summary, digital technology empowered students to engage in conversations via chat rooms and breakout rooms (communication), and to review and critique others' work using shared screens (critical thinking). They could work together on the choreography in different places and in different combinations (collaboration) using non-traditional dance spaces, which made their final work more versatile and engaging than the work done in classes held in studios.

3.2. Quantitative data collection and analysis

In the quantitative data analysis, a correlation analysis and paired samples *t*-test were performed using SPSS 24 software. The confirmatory factor analysis for validating the measures was carried out with AMOS software.

3.2.1. 4C skills

This consisted of 16 items designed to measure four subscales: creativity, collaboration, communication, and critical thinking. There were four items in each subscale. The survey was adapted from existing survey items created by Hughes (2014) and Ravitz (2014). The Chinese version of the items was administered after following a standard back-translation process. The internal consistency of each subscale was acceptable, ranging from .63 to .77 in the pre-test and from .71 to .75 in the post-test data. Subsequent confirmatory factor analysis of this four-factor model showed an acceptable model fit: $\chi^2 = 134.62$, $df = 96$, CFI = .91, TLI = .88, RMSEA = .075, 90% CI [.042, .103], SRMR = .077. All the parameter estimates were significant at the $p < .001$ level, and the standardized estimates for all items were acceptable, ranging from .43 to .75.

3.2.2. Self-efficacy

Students' self-efficacy was measured with the 5-item Disciplinary Self-Efficacy Scale (Gehlbach & Artino, 2018), which has been shown empirically to be a reliable and valid scale for assessing self-efficacy within a discipline or profession (Krosnick & Presser, 2010). In the current sample, the Chinese version of the items showed excellent reliability (Cronbach's $\alpha_{pre-test}$ was .91, and Cronbach's $\alpha_{post-test}$ was .90). The measurement model of self-efficacy showed a perfect model fit: $\chi^2 = 4.85$, $df = 5$, CFI = 1.00, TLI = 1.00, RMSEA = .000, 90% CI [.000, .161], SRMR = .024.

3.2.3. Course satisfaction

We developed seven items to measure students' satisfaction with this course. In the current sample, the scale showed great reliability (Cronbach's $\alpha_{pre-test}$ was .86, and Cronbach's $\alpha_{post-test}$ was .84). A measurement model of course satisfaction also showed a good model fit: $\chi^2 = 18.28$, $df = 13$, CFI = .97, TLI = .96, RMSEA = .075, 90% CI [.000, .149], SRMR = .057.

3.3. Qualitative data collection and analysis

Qualitative data were collected from both the students and class instructor to provide more detailed information to help interpret the quantitative results and achieve the goal of triangulation. First, all the students were invited to respond to open-ended questions to elicit their views about using Zoom in the dance class in the post-test. These questions covered difficulties encountered in the Zoom-based dance class; experience of using Zoom; and perceived advantages/disadvantages of a Zoom-based dance class compared with face-to-face classes. In total, seventy-eight students responded.

Second, the instructor made his observations in and out of class. Based on the research questions and the 4C skills framework used

in this study, both synchronous and asynchronous observations were made. During synchronous observations, the instructor provided comments to students as he monitored their in-class creative process in front of the computer screen. This type of observation was also made when small groups of students were working in breakout rooms. The instructor was able to move freely between the breakout rooms to listen, observe, and monitor students' progress and facilitate their discussions. These observations were intended to motivate and encourage students to think outside the box while balancing the power dynamic, particularly in small group settings, by making sure that everyone could share and contribute to the final product. The use of breakout room was effective in promoting student engagement and inclusion, especially when some students preferred to participate by texting instead of engaging verbally. This appeared to provide a safe way to take part for students who might not necessarily participate in discussions during face-to-face classes (Singhal, 2020). Asynchronous observations were conducted after class. The instructor took time to review the recording of the lecture in terms of what happened during the class. He took notes, and evaluated the flow of the class, the activities, and the student presentations. During this process, students' ongoing projects were commented on with specific remarks and constructive suggestions for improvement. Both synchronous and asynchronous observations were important in developing 4C skills and self-efficacy among students due to their constructive and reflective characteristics. All the responses were documented in Chinese which served as the basis for the analysis. The selected quotations were translated into English by experts to ensure consistency between the Chinese and English expressions.

3.4. Integration and interpretation of data

Given the mixed-methods research design, the qualitative data (student responses to open-ended survey questions) were analyzed using an integrated approach (Bradley et al., 2007). The analysis (carried out by the first author) commenced by reading each of the responses as whole cases, rather than as segments compartmentalized according to the research questions. This aimed to form a first impression of emerging individual differences and of the conceptual themes. The first author then used inductive thematic coding to categorize the emerging themes according to the current research focus (the 4C skills, self-efficacy, and course satisfaction). The second author examined the codes and identified the emergent themes using the constant comparative method, paying particular attention to deviant cases, and coded the transcripts separately. The two authors read over the coded data together to discuss and resolve discrepancies where possible. The first author also analyzed the instructor's observations to delineate students' learning processes and skill development during the course from the instructor's point of view. The observer (i.e., the course instructor) identified and documented the key attributes of each instance of learning and skill development that occurred during a Zoom lesson. The key elements of the observation included the type and level of student engagement, and the type and level of students' 4C skill development.

The third author analyzed students' quantitative responses to the survey questions using SPSS. This type of data provided a more comprehensive data set to enhance the generalizability of our study. The range of perspectives that were gained from the triangulation of the data obtained from the different approaches further enriched our understanding of any given phenomenon, and both qualitative and quantitative data were examined concurrently to clarify whether the findings generated by each method converged with or supplemented each other. The integration of the research findings from qualitative and quantitative techniques in the same study can maximize the affordances of each approach, providing a better understanding of the effectiveness of using Zoom in a dance education context than either approach alone. For example, the numeric scores from each subscale in the student survey were further elaborated by the open-ended responses and classroom observations. The qualitative findings from specific cases could be further validated by the quantitative statistical results generated by a larger sample.

Table 1
Bivariate correlations among variables ($N = 73$).

Variables	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.
<i>Pre-test</i>												
1. Creativity	-											
2. Collaboration	.70***	-										
3. Communication	.77***	.62***	-									
4. Critical thinking	.72***	.60***	.59***	-								
5. Self-efficacy	.73***	.56***	.67***	.55***	-							
6. Course satisfaction	.45***	.36**	.50***	.43***	.40***	-						
<i>Post-test</i>												
7. Creativity	.50***	.42***	.47***	.35***	.41***	.45***	-					
8. Collaboration	.52***	.50***	.54***	.41***	.45***	.58***	.74***	-				
9. Communication	.51***	.49***	.65***	.41***	.48***	.57***	.77***	.82***	-			
10. Critical thinking	.53***	.41***	.52***	.44***	.52***	.37**	.73***	.73***	.73***	-		
11. Self-efficacy	.55***	.37**	.52***	.46***	.69***	.54***	.52***	.57***	.62***	.53***	-	
12. Course satisfaction	.44***	.36**	.50***	.33**	.33**	.68***	.43***	.64***	.60***	.41***	.49***	-
Skewness	.26	.36	.26	.11	-.07	.13	-.18	-.11	-.38	.14	-.11	-.99
Kurtosis	-.27	-.21	-.54	.45	-.34	.24	.06	-.43	.01	-.39	.26	3.60
Reliability coefficient	.63	.70	.73	.77	.91	.86	.75	.75	.74	.71	.90	.84

Note. ** $p < .01$; *** $p < .001$.

4. Results

4.1. Descriptive and correlational analyses

The ranges of skewness (from $-.99$ to $.36$) and kurtosis (from $-.54$ to 3.60) for all the main variables were acceptable (Brown, 2006). The correlation coefficients for the main variables are presented in Table 1. All four facets of the 4C model were significantly and positively associated with self-efficacy and course satisfaction. Bivariate correlation analyses showed moderate to strong associations among all the main variables in both pre-test ($r = .36$ to $.77$, $ps < .01$) and post-test data ($r = .43$ to $.82$, $ps < .01$).

4.2. Changes in 4C skills

We used qualitative and quantitative data sources to address the changes in students' 4C skills. According to our quantitative analysis, comparing the results of the pre-test to the post-test after using Zoom over one semester, we found significant improvements in self-reported creativity (Mean_{pre-test} = 3.91, $SD_{pre-test} = .48$; Mean_{post-test} = 4.04, $SD_{post-test} = .53$, $t = 2.14$, $p < .05$), and collaboration skills (Mean_{pre-test} = 3.87, $SD_{pre-test} = .50$; Mean_{post-test} = 4.01, $SD_{post-test} = .56$, $t = 2.18$, $p < .05$). No significant results were observed in critical thinking and communication skills (see Table 2).

Our qualitative analysis from both instructor observation and students' open-ended question responses indicated that the use of Zoom offered students ample opportunities to collaborate and innovate more efficiently. For example, prior to the pandemic, when dance classes took place face-to-face in the studio, the instructor frequently asked students to work with different partners in various group settings. Very often, more than half of the first class was dedicated to "ice-breaking" activities for students from different faculties to get to know each other. When teaching moved online, breakout rooms in Zoom were used by groups of three-to five students sharing their thoughts and views on specific topics. In these online dance classes, students quickly figured out their strengths and weaknesses, identifying who was able to do what by chatting with each other in various settings. Efficient collaboration was also assured by effective role assignment within a study group. For example, students with dance backgrounds nominated themselves as choreographers while others took up roles in dancing, video-editing, sound mixing, subtitling, and developing special effects, based on their personal interests as well as their current skill level.

Students' responses to the open questions corroborated the above findings. Analysis of the open questions showed that students actively collaborated in their group project. The message exchanges also revealed that the Zoom environment functioned well in promoting student-centered collaboration. For example,

Learning dance on Zoom can initiate interaction with my fellows and the teacher, and the teacher can still teach the movement to complete the course without being affected [by COVID-19].

One advantage of learning dance with Zoom is the innovative ways of collaborating.

Our findings are also in line with recent research into which online technology tools boost student creativity (Yang et al., 2018). An important observation the instructor made was that the limited space and time of the online dance class significantly restricted the choreography. Performing in front of a camera can be more intimidating and less natural than performing in front of a real audience, with greater difficulty in connecting effectively with the audience. This demanded a different approach from face-to-face teaching in a studio. For example, the instructor shouted key action words into the microphone, such as "jump up," "reach low," "turn around," "stretch to the side," and "curl your torso," rather than explaining or demonstrating each concept fully, as would have happened in a face-to-face context. These succinct instructions could have made the creation of choreography more challenging than before, yet it also forced students to think outside the usual bounds, which triggered different move actions. Students in a small home space also tended to focus on non-locomotor movements in the choreography by contracting and extending their bodies in various directions with different timings, as the confined space pushed everyone to think harder about how to express themselves more creatively. Students with more room expanded their movements to fully occupy their living spaces. Students inspired each other by observing how others used various spaces creatively. This was different from face-to-face classes, where students used a fairly similar space. In online environments, students tended to come up with choreography that they normally would not come up with in face-to-face settings. Creativity and imagination were constantly encouraged within the limited space available without sacrificing the quality of the choreography.

Table 2

Comparison of pre-test and post-test scores for main variables.

Variables	Pre-test Mean	SD	Post-test Mean	SD	t	p value
1. Creativity	3.91	.48	4.04	.53	2.14*	.036
2. Collaboration	3.89	.50	4.01	.56	2.18*	.033
3. Communication	4.13	.49	4.11	.51	-.42	.677
4. Critical thinking	3.87	.49	3.88	.50	.17	.867
5. Self-efficacy	3.80	.64	3.68	.65	-2.03*	.047
6. Course satisfaction	3.51	.68	3.68	.64	2.78**	.007

Note. * $p < .05$; ** $p < .01$

4.3. Changes in self-efficacy

Surprisingly, a significant reduction was observed in students' average self-efficacy scores ($\text{Mean}_{\text{pre-test}} = 3.80$, $\text{SD}_{\text{pre-test}} = .64$; $\text{Mean}_{\text{post-test}} = 3.68$, $\text{SD}_{\text{post-test}} = .65$, $t = -2.03$, $p < .05$). Students' subsequent responses to the open-ended questions provided two explanations of the observed decrease: the option of turning off cameras and the misconceptions about the workload. First, when the online course began, almost all the students kept their cameras on during the lesson, regardless of the device they used to participate. Then, several weeks into the semester, after a few students complained, the university announced the no-camera-on policy. This had a huge effect on students' self-efficacy as they no longer had to show what they did behind the camera. Many students chose to turn off their camera and replaced it with a profile image. The instructor thus could no longer see students whose cameras were switched off and could not obtain sufficient information to judge attention and comprehension (getting similar feedback from the class as one would in face-to-face settings). With no access to how students responded to the course during a lesson with cameras off, the instructor was not able to assess the pace and readiness of each student (Lännström, 2020). Seeing students' reactions on camera allowed the instructor to easily tell who was experiencing difficulties in a given task and who was on the right track. This was also linked to students' performance during the course—the instructor noted that students who kept their cameras on throughout gained better final grades. Two students who failed the course had never turned their cameras on after the policy was implemented. For example,

The advantage of using Zoom is that we feel like participating in a real class. However, some people may be sneaky and not turn on the camera during class.

The advantage of using Zoom is that you can find the most comfortable way for you to attend the online class at home. You can also record the class content by capturing the screen for further studying and reviewing. However, some students may just log in to the Zoom account and turn off the camera. The teacher might not be aware of what they were doing in class.

Second, the participants shared some misconceptions of the workload involved in a dance course. Many students thought that the course would be an easy class to take, and some even believed it was like a gym where they would learn ballroom dancing or hip hop. Instead, the course focused on choreography, creativity, and critical thinking more than just physical dancing. With the transition to the online teaching model, the difficulties and challenges intensified. A great many visual resources, where students could see, experience, and discover what dance really means and what it takes to achieve a good level, were lacking. The integration of technology made things even more complicated as students had to not only dance in front of the camera, but also gather visual resources, edit videos, and mix music. The students' idea of what a dance course involved versus the reality (technology, technique, and virtual setting) made some feel discouraged and overwhelmed. For example,

I cannot follow what the instructor taught in class, and I had to spend more time to watch and practice after the class.

In making the video, I need to find some editing apps and learn how to use them to solve my problem. Dance is easy, but technology is hard, really hard.

Related to the above point was the dramatic difference in dance skills and backgrounds among students. Some students came with years of dance training while others were still trying to be sure which leg to move first. Nonetheless, they were all faced with different challenges. For the experienced students, they soon realized that they had to learn various choreographies and that some of the dance movements were difficult. The more difficult part was how to respond critically when these students were challenged with high-order thinking questions by the instructor and their peers, such as "How about turning the other way and twisting your body instead of stretching?"; "Why don't you pause for a bit; what is the meaning behind this movement?" Such questions were mostly related to the logistics behind movements, steps, and emotions. As technology opened up a wide range of opportunities for the instructor to deliver such thought-provoking questions on both a group and an individual basis, students with less training were made aware of their weakness in basic dance preparation. As a result, students' overall self-perceptions were somewhat stifled by the perceived difficulty of completing assignments in this course, as shown in their responses to open questions:

I can pay extra attention to the moves and record them to have a reference point later on when my teacher gives us time to practice the moves.

While doing the dance combination assignment, sometimes it is hard to remember all the movements. Therefore, I will try to watch carefully and record the dance before I follow the professor dancing the next few times.

4.4. Changes in course satisfaction

Overall, students were more satisfied with the course ($\text{Mean}_{\text{pre-test}} = 3.51$, $\text{SD}_{\text{pre-test}} = .68$; $\text{Mean}_{\text{post-test}} = 3.68$, $\text{SD}_{\text{post-test}} = .64$, $t = 2.78$, $p < .01$) after using Zoom for one semester. Based on their responses to the open questions, the improvement in their course satisfaction could be explained in two aspects: sense of community, and sense of accomplishment.

A sense of community was developed in Zoom breakout rooms. Students could easily interact with a small number of peers and felt comfortable in sharing their work. They could see each other on their screens and share their thoughts using words, images, and videos to elaborate on their ideas, as well as showing their own work. The instructor could drop into different breakout rooms to check on students' learning and provide individual feedback whenever necessary. As the instructor observed, students had more freedom to express themselves in an online situation. Meanwhile, other students could send emoji and encouraging words while an individual

student was presenting online. That increased the presenter's sense of community in a way that is hard to achieve in face-to-face classrooms. For example,

I didn't have classmates to communicate with about the course in the beginning, but then [in Zoom] I found some friends and group mates to talk about the course and to solve difficulties together.

A sense of accomplishment was also seen in students when they presented their group work using Zoom's share screen feature in the final class. After each presentation, the group leader spoke with excitement about how they put the work together. Then, other students posed questions on certain parts of the work and a lengthy conversation took place. The instructor also observed that a number of students shared their final work on social media channels and received numerous likes. Through chat logs, dance students were proud of what they had achieved, despite the large amount of time in editing, rehearsing, and repeating. "All the hard work paid off;" and "No pain, no gain," were lines they posted when sharing on social media. A few students told the instructor that they even posted their group work on well-established streaming channels to celebrate their achievements, something that they rarely did for other courses.

5. Discussion

Given the lack of research into the use of online tools for holistic student development in dance education in China, the current mixed-methods study provides empirical evidence of the effectiveness of technology in promoting the desired outcomes (i.e., 4C skills, self-efficacy, and course satisfaction) for dance students during the pandemic. It demonstrates the value of using Zoom for this purpose by collecting data from multiple sources. Both the qualitative and quantitative results showed that students were capable of managing virtual dance classes. The use of Zoom provides opportunities that were not available in face-to-face classrooms to support student development over and above dance techniques.

Collaboration is an inherent part of many dance pedagogies and dance practices. Outside of dance, the ability to collaborate is prized in a variety of disciplines as a highly valuable competency, as it encourages confidence, creates community and content mastery, while affirming dance learning (Parrish, 2016). Researchers have documented students' favorable attitudes toward online collaboration in arts disciplines (McCabe, 2007). In this study, survey responses showed significant increases in students' collaboration skills after taking this course. Classroom observations provided additional evidence to elaborate on how students collaborated and the emotional and attitudinal changes toward collaboration. Various Zoom functions strongly influenced student collaboration during the class, making collaboration easier, more accessible, and efficient. Consistent with Scovotti & Spiller's (2011) report, videoconferencing tools enabled students to work together remotely, build valuable relationships between group members, provided greater transparency to the project's components, and created team synergy.

Both students' self-reported responses and the instructor's observations supported the role of Zoom in cultivating creativity, which is consistent with Bui et al. (2020) observation that videoconferencing tools helped students to improve their creativity, although at a mediocre level. Kirsh (2010) asserted that dancers used their bodies as tools to think with, hardly differentiating between thinking and moving while creating. The creative ideas emerged from interactions between mind and body, from the body's disposition, from interaction with the surroundings, objects, and with gravity, and with each other and each other's bodies (Łuczniak, 2015). When creativity was strongly encouraged during teaching, the sense of freedom students gained was expected to be developed in the learning environment (Chang & Yu, 2015). Such a free and supportive climate has been found to be highly positively correlated with personal creative performance (West & Sacramento, 2012).

As indicated by the preceding discussion, the alignment between our qualitative and quantitative data validated the findings from each source. There were also instances where the qualitative data further enriched the quantitative information by providing more in-depth explanations. For example, researchers expected students to be equipped with evaluation skills that allowed the synthesizing of ideas and which challenged their habitual movements and notions of what dance could be (Akinleye & Payne, 2016). However, we did not observe significant changes in students' critical thinking in terms of choreography, dance presentation, and movement analysis. The literature has documented several reasons for the lack of critical thinking in dance classrooms. For instance, Akinleye & Payne (2016) also noted a need for explicit communication with students about the links the instructors made between feedback and critical thinking to develop a culture of critical thinking in the classroom. As observed by the instructor in this study, some students experienced difficulties in responding to challenging questions and failed to apply critical thinking to their dancing, as shown by their slow and reluctant participation in such learning activities.

Our quantitative data also indicated that students' communication skills did not show a significant increase, despite increased online collaboration, suggesting that students' ability to communicate might not be improved by integrating Zoom into dance teaching. This contradicted Lai & Hwang's (2014) finding that the more time the students engage in mobile learning, the better their communication skills. We speculate that this is related to the no-camera-on policy. Social presence is an important component of effective learning in an online learning environment (Al-Dheleai & Tasir, 2019). Encouraging camera use probably would increase social presence by helping all parties to become better known (Adair et al., 2021). Research has confirmed that students learn when they feel connected with others and when they played an active role in the learning process (Al-Dheleai & Tasir, 2019). Hence, camera use might encourage learner interaction and communication by increasing learners' social presence (Adair et al., 2021). Another possible reason is that daily use of digital technology for personal reasons may be different from using the same technology for academic purposes. Although students tend to use the technology in class in the same way as they use it outside class, Torres-Gastelú et al. (2015) reported that 40% of students considered themselves not to be competent in communicating academic information using digital media. This echoed Leijen et al. (2008) observation that many of the students in their study found it difficult to communicate with others without being able to see their non-verbal communications when working on group dance projects.

Consistent with previous studies (Nie & Hu, 2018), we found that the use of online tools such as Zoom significantly increased students' satisfaction. Students' satisfaction was influenced by various factors including pedagogical strategies (Almusharraf & Khahro, 2020). The instructor in the current study adopted an ABC approach to dance choreography, in which students were invited to (A) copy what the instructor did, (B) create a new movement phrase, and (C) merge the two parts into a related creative work. Remodeling the pedagogy to fit online teaching to maximize learning outcomes became urgent and necessary in the virtual environment so that the students were provided with equal or even greater opportunities to learn, analyze, create, and integrate all they were taught, just as if they were in a face-to-face environment. Furthermore, it is worth noting that students' improved 4C skills would potentially influence their course satisfaction (Bangert, 2006; Landrum, 2020; Zhu, 2012). As shown in Table 1, we observed that students' 4C skills, self-efficacy, and course satisfaction were significantly positively associated between each other, indicating that students with higher levels of creativity and collaboration tended to be more satisfied with the course. In light of these findings, attending to student development beyond dance knowledge and techniques seemed to be a positive reinforcer for increasing course satisfaction with the use of Zoom.

An unexpected finding in this study was the negative impact of using Zoom on students' self-efficacy. Hodges & Murphy (2009) specified various sources of students' self-efficacy beliefs in a technology-intensive asynchronous course. Given that this dance course was offered in a format that was non-traditional and unfamiliar, the students might perhaps be putting the most weight on their ability to succeed in this environment. Furthermore, not all the students who enrolled in this course were experienced in dance. They might thus have experienced a high degree of dance anxiety or at least some negative feelings toward their dancing abilities. Our qualitative data provided another potential explanation in that the integration of the technology might have increased the workload or the cognitive load for the students. Unlike the face-to-face dance class, the online learning environment with technological implementation required students to not only dance in front of the camera, but also gather visual resources, edit videos, and mix music. Students' concerns about whether they had the necessary digital skills for such purposes were expressed in their survey responses. The instructor also observed these concerns in the form of their non-satisfactory performance in their group work. These might somehow hamper students' self-efficacy.

6. Limitations and future directions

The current findings need to be interpreted with caution. First, the sample size was small, focusing on an elective dance course in a higher education context in China. Further research with a larger sample is warranted to improve its generalizability. Second, the self-efficacy measure was fully saturated, which is not very realistic in psychological research. This indicates that the current model could be simplified (Blunch, 2008). Further research with a more varied sample is necessary. Also, the cross-sectional design does not allow us to reach any causal conclusions. A longitudinal or experimental design is recommended to identify the causal effect of using Zoom on various outcomes. Finally, although the mixed-method design in this study provided multiple views of the research questions, a richer data source is warranted. This might include a constructive interview with the course instructor, reflection notes by the students or online platform logs to elicit a deeper understanding of their experience of the course in the dance classroom.

7. Implications and conclusion

McCarthy et al. (2004) meta-analysis indicated that art education in general strengthened students' cognitive functions, attitudinal and behavioral skills, including self-efficacy and empathy, social skills, and others. Our findings support the previous notion that employing technology significantly increases students' 21st century core competencies, such as creativity, collaboration, and complex problem-solving (Lai & Hwang, 2014). Dance education incorporates learning in, through, and about dance (Rowe et al., 2018). Research into dance education can therefore consider critical questions about the ways we learn to dance, what we learn about dance as a subject, and how dancing helps us learn about ourselves (Risner, 2010). The pandemic presents tremendous challenges for dance education, which typically requires close interaction, collaboration, creative thinking, and practice. Our experience of using Zoom in dance teaching exemplifies a teaching and learning model that adds value to the learning process and to the overall development of the students in the dance classroom. This approach embraces new methods that allow 21st century dance training to better respond to new challenges in global education.

The widespread implementation of online tools is shaping a new teaching and learning platform for higher education. One of the most complex challenges relates to viewing dance education from a different perspective, one that contrasts with the traditional face-to-face modality when shifted to an online mode (Astaiza et al., 2021). The results of this study showed that Zoom was an effective tool for teaching dance in higher education during the pandemic. In particular, not only did it allow the development of an agile and responsive curriculum to meet the diverse needs of the students, but it also greatly stimulated students' creativity and collaboration skills, leading to greater satisfaction with the course. We believe that using Zoom injects new vitality into traditional face-to-face dance education in China by transforming the emphasis on acquiring knowledge (theory) and skill (technique) into achieving the goal of nurturing the whole person. Indeed, videoconferencing platforms provide an active, flexible, and convenient learning environment to position students at the center of dance learning. This subsequently affects students' understanding of the discipline as well as their responses to and engagement in learning activities.

Broadly speaking, the COVID-19 pandemic has had a profound effect on all disciplines. This timely study sheds light on both theory and practice in dance education. Theoretically, our findings improve our understanding of the psychoeducational benefits of integrating Zoom into dance teaching in higher education. The results lay the foundation for the establishment of new models of online dance teaching and learning. They also contribute to other practice-based subjects, such as physical education and art education.

Practically, the benefits of online tools and educational technologies are evident in optimizing the teaching and learning of dance. We believe that the effective use of these tools will drive the development of new pedagogies, which will help students cultivate 21st century skills, develop holistically both during the pandemic and after it. However, it is noteworthy that the use of technology in dance education should not be viewed as an end in itself (Dania et al., 2011). Researchers urge that technology should be embedded into teaching strategies and that institutions should encourage teachers and students to co-develop, co-create, and co-sustain an effective learning environment (Kassem, 2018; Kaliisa and Michelle, 2019). Thus, teachers can rebuild their pedagogy to achieve greater, more positive influence over the construction and application of students' knowledge. Any judgment about the effectiveness of such pedagogy should come as the result of the assessment of multiple aspects of student development. To be effective in any educational context regardless of the means used to communicate knowledge, the focus needs to shift from the choice of the technology to use in the dance classroom to the pedagogy adopted in teaching dance. It is our conviction is that such an approach to the teaching of dance opens the door to truly creative innovations.

Ethical approval

All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

Informed consent

Informed consent was obtained from all individual participants included in the study.

CRediT authorship contribution statement

Zihao Li: Resources, Formal analysis, Data curation, Writing – original draft, Writing – review & editing, Writing – original draft, Writing – review & editing. **Mingming Zhou:** Conceptualization, Validation, Supervision, Writing – original draft, Writing – review & editing. **Kelly Ka Lai Lam:** Data curation, Writing – original draft, Writing – review & editing.

Declaration of Competing Interest

None.

Data availability

Data will be made available on request.

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