Significance and Possibility of E-Learning for Choreographic Skills in Contemporary Dance

Bin UMINO[a*], Asako SOGA[b] & Motoko HIRAYAMA[c]

[a]*Faculty of Sociology, Toyo University, Japan*
[b]*Faculty of Science and Technology, Ryukoku University, Japan*
[c]*Faculty of Health and Sport Sciences, University of Tsukuba, Japan*
*umino@toyo.jp

Abstract: In this paper, we introduce a learning methodology for choreographic skills in contemporary dance using the "Body-part Motion Synthesis System (BMSS)," which actualizes "analytic-synthetic choreography." The software allows students to select body-part motion clips of basic dance movements and compose a short dance motif, which is previewed using 3D animation. Experiments on learning choreographic skills with the software were conducted in order to evaluate its usability. Data were collected from 26 students using a questionnaire. From the results of the experiments, we verified that the software's usability is acceptable and that our e-learning method for contemporary dance is effective for learning choreographic skills.

Keywords: E-learning, choreographic skills, motion data, contemporary dance

1. Introduction

Although computational methods for dance creation have advanced significantly over the past two decades, there are only a few dance teachers who utilize computers to teach dance skills in their classes. Using computers in dance education has always been contentious because dance has the distinction of being both somatic and artistic. Somatic skills essentially need to be learned through physical practice, and it is currently difficult for computer devices to support the experience of physical action unless the teacher has access to costly hardware. Artistic skills need to be learned through an individual's creativity, but dance people generally believe that it would be almost impossible for a computer to inspire creative feelings or intuitions in a purposeful manner.

However, some researchers in dance education have reported the impact of computer technology on dance learning (e.g. Smith-Autard, 2009; Leijena, Admiraala, Wildschut and Simons, 2008). In particular, 3D animation and motion capturing technology have expanded the capability of e-learning for dance. Karkou, Bakogianni and Kavakli (2008) developed a web-based learning environment using 3D animation for traditional dances in the U.K. and Greece. Moreover, both Matsumoto, Miura and Kaiga (2011) and Shibata, Tamamoto, Kaiga and Yokoyama (2012) developed e-learning tools that could display 3D animation of model performances made from motion capture (MoCap) data for traditional dances in Japan.

The authors have been working on dance education and creation using 3D motion data that were captured from performances by professional dancers. This paper introduces a specific teaching methodology for choreographic skills in contemporary dance utilizing e-learning software that we have been developing in order to actualize "analytic-synthetic choreography," which is described in Section 2. The methodology targets undergraduate and postgraduate students who are studying contemporary dance choreography. The software is called "Body-part Motion Synthesis System (BMSS)," and it is described in Section 3. Experiments on learning choreographic skills with the software were conducted in order to evaluate its usability. Data were collected from 26 students in Japan and the U.S. using a questionnaire, which is described in Section 4.

2. Pedagogy of Choreography

2.1 Top-down and Bottom-up Approaches

In general, a choreographic process is carried out in a top-down approach. A choreographic work is composed of many artistic elements other than dance movements, such as narrative, music, sound effects, lighting, scenography and visual effects, costumes and stage make-up. Professional choreographers attempt to integrate all of these elements into their work coherently according to their own choreographic planning. The planning usually precedes the creative process of dance movements and theatrical audio-visual elements. Choreographers sometimes choose a specific narrative or a given musical score as a point of departure for their creation, but after that the process is likely to be a top-down approach.

Choreographic skills are normally taught to students at universities as a top-down approach, just as a professional choreographer normally works. They are required to formulate their own choreographic planning and implement it in their choreographic works. Most teachers of choreography place heavy emphasis on a holistic concept and the consistent structure of choreographic works at higher educational levels. Beyond that, the concepts that the teachers suggest tend to be expressionistic ones using narratives, emotions, or feelings to set up the choreography.

However, the authors believe that bottom-up and non-expressionistic approaches would also be vital and effective ways to master choreographic skills in contemporary dance. The students need to have the experience of composing dance movements without narrative, emotions, music, and all other audio-visual elements except for the dancers' bodies. This is because the pursuit of novel movements with the intention of independence from concrete references in the world characterizes the contemporary dance scene of the day. Contemporary dance can be described as an artistic dance without any common or standard choreographic vocabulary. A number of legendary twentieth-century choreographers, such as Rudolf Laban (1879-1958), Merce Cunningham (1919-2009), and the early William Forsythe (1949-) sought to produce their original dance movements without narrative, emotions, and music. Such an abstract way of dance composition should be taught as part of learning choreographic skills at universities lest the students' works be produced from only derivative material.

2.2 Analytic-synthetic Choreography

It is more difficult, but an exciting challenge, for choreographers to adopt the bottom-up and non-expressionistic approach than the top-down and expressionistic one. Computer technology sometimes helps them to pursue the abstract way. Cunningham famously pioneered the use of the choreographic software Life Forms in the late 1980s, while Forsythe used moving picture processing and hypertext technology to explain his unique algorithmic method of creating dance movements in the late 1990s (Forsythe, 1999).

The authors found that 3D animation made from MoCap data could be a powerful e-learning tool for learning choreographic skills in contemporary dance in the bottom-up approach. The basic idea of the method is to segmentalize dance movements performed by professional dancers into short elemental motions and then synthesize these segments as building blocks to create new movements. Both the elemental motions and the synthesized movements can be simulated easily and instantly as 3D animation. We call this method "analytic-synthetic choreography."

The segmentalization of dance movements is transacted in a double way. First, the dance movements digitized by a motion capture system are separated into basic whole-body movements along the time axis, such as stamping forward, sliding aside, bending the knees, and toppling in an off-balanced way. Second, the whole-body movements are articulated to extract basic body-part motions, such as contraction of the breast region, rotating the head, shaking the left leg, and crossing the arms in front of the body. Single elemental motion of the whole body or a body-part lasts a few seconds.

Meanwhile, the synthesis of dance movements is transacted in a triple way. First, you can select several whole-body movements and combine them in a row on the time axis to create a short dance sequence. For example, if you select three movements which are denoted by A, B, and C, then you can create ABC, BAC, ACBA, CBCAAB, and so on. Second, you can blend one whole-body movement into another whole-body movement. For example, if you select the sliding aside movement, then you can add the bending the knees movement to it at any timing you decide. The movements are overlapped on the time axis unlike in the first way. Third, you can replace part of a whole-body movement by a body-part motion. For example, if you select the stamping forward movement, then you can replace the head by rotating movement and the arms by crossing in front of the body. The movements are overlapped in this way as well.

The authors developed e-learning tools that actualized the first synthetic way for learning classical ballet (Soga, Umino, Yasuda and Yokoi, 2007; Umino, Longstaff and Soga, 2009) and hip-hop dance (Soga, Tsuda and Umino, 2014). In addition to these tools, the authors have developed an e-learning tool for contemporary dance that actualizes the second and third synthetic ways of creation, as described in Section 3.

The learning methodology based on analytic-synthetic choreography consists of three phases: (i) students create short dance motifs using the software and simulate them as 3D animation on the display of a computer; (ii) students try to perform the motifs by mimicking the 3D animation by operating their own bodies; and (iii) students create and perform their own short dance sequences by combining, arranging, and sophisticating the motifs in a studio. The second and third phases are essential for students to discover and develop their own creative process by themselves. Experiments were conducted according to the methodology, as described in Section 4.

3. Body-part Motion Synthesis System

The software BMSS has been developed to actualize analytic-synthetic choreography (Kohno, Soga and Shiba, 2010). In this research, 40 basic motions were selected meticulously as elemental motions so that dance students could use the system easily within a short span of time. Each motion’s potential for synthesis was analyzed, and the 40 motions were categorized into 3 main groups: Base motions, Blend motions, and Body-part motions. Base motions consist of whole-body movements. Blend motions consist of whole-body movements that are able to be blended together with a Base motion. This group mainly consists of hip movements like jumping and twisting motions. Body-part motions consist of movements that involve only specific body parts or limbs. This group is further categorized into five sub-groups: Body, Neck, L-Leg (left leg only), Shoulders, and Arms.

The system creates movements by the synthesis of a Base motion, Blend motions, and Body-part motions. It has two modes: Blend mode corresponds to the second synthetic way mentioned in 2.2; Replace mode corresponds to the third one. In the Blend mode, the selected Blend motion of the whole body is blended with a Base motion in a way that the vector of the Blend motion for each joint in every frame is added to that of the Base motion. For example, when a user selects sliding aside as a Base motion and bending the knees as a Blend motion, a sliding motion with bending knees is created. In the Replace mode, the system replaces motions of specific body parts with different Body-part motions.

There are currently two versions of BMSS. The old version runs on a notebook PC with keyboard input, and the latest version runs on a tablet with touch input. The sets of 40 motions are slightly different, and the old version does not implement the Blend mode. Despite the differences, they are underpinned by the same learning methodology explained above. Table 1 shows the number of motions and examples of motion codes in each category.

Table 1: Number of motions and examples.

<table>
<tr><th colspan="2" rowspan="2">Category</th><th colspan="4">Number</th><th rowspan="2">Example</th></tr>
<tr><th colspan="2">Notebook PC</th><th colspan="2">Tablet</th></tr>
<tr><td colspan="2">Base</td><td colspan="2">15</td><td colspan="2">10</td><td>Stamp, Slide, OffBalance, Soutenu</td></tr>
<tr><td colspan="2">Blend</td><td colspan="2">0</td><td colspan="2">6</td><td>BendDown, JumpUp, JumpPivot</td></tr>
<tr><td rowspan="5">Body-part</td><td>Body</td><td rowspan="2">10</td><td rowspan="5">25</td><td>5</td><td rowspan="5">24</td><td>Contract, BustRoll, SideSwg, Wave</td></tr>
<tr><td>Neck</td><td>3</td><td>Down, Side, Round</td></tr>
<tr><td>L-Leg</td><td rowspan="2">5</td><td>5</td><td>Bend, InOut, LegShake, FootRound</td></tr>
<tr><td>Shoulders</td><td>3</td><td>UpDown, Shake, Roll</td></tr>
<tr><td>Arms</td><td>10</td><td>8</td><td>RaiseUp, PushFront, CrossFront</td></tr>
<tr><td colspan="2">Total</td><td colspan="2">40</td><td colspan="2">40</td><td></td></tr>
</table>

Figure 1 shows the GUI of the tablet version of BMSS. It employs only one window, which consists of a virtual environment and GUI components. The GUI components such as buttons are layered over the virtual world. The codes of all 40 motions are listed as buttons. First, you select a Base motion and the system displays it by 3D animation with a virtual dancer. Then, you select Blend motions or Body-part motions. The Base motion and the selected motions are synthesized, and the result will be displayed instantly. The system also has functions to support dance creation such as changing the viewpoint and saving the synthesized movements (Soga and Matsumoto, 2013).

Figure 1. GUI of BMSS for Tablet.

4. Experiment

4.1 Method of Experiment

Experiments were conducted using both the notebook PC version and the tablet version of BMSS. The experiments aimed to evaluate the usability of the software. From the point of view of learning choreographic skills, usability is the most important aspect of the e-learning tool. Usability is defined in ISO 9241 as “The effectiveness, efficiency and satisfaction with which specified users achieve specified goals in particular environments.” The users of the software are assumed to be students who study contemporary dance at universities. The goal of using BMSS is to learn skills in contemporary dance based on analytic-synthetic choreography. To evaluate the usability of BMSS, five questions were prepared preliminarily:

- Can dance students master the system to create dance motifs in a short span of time?
- Can dance students be satisfied with the system for learning dance movements?
- Can dance students be satisfied with the system for creating new dance movements?
- Can dance students discover new dance movements they did not know before?
- Can dance students discover new choreographic skills they did not know before?

The 26 examinees consisted of 18 students who majored in contemporary dance at University of Tsukuba in Japan and 8 students who belonged to the Department of Dance, University of California, Irvine, in the U.S. Here, 16 out of the 26 examinees were postgraduate students. They studied not only contemporary dance but also other genres of dance for 4 to 40 years. 8 out of the 18 Japanese students used the notebook PC version, and the remaining students used the tablet version.

The examinees gathered in a gymnastic studio and formed groups, each of which consisted of four or five students. After brief instructions on the software, the experiments were implemented in three phases: (i) the examinees tried to create short dance motifs on the display; (ii) they tried to perform the selected motifs by operating their own bodies; and (iii) they were requested to create their own dance pieces by selecting and connecting the short motifs. In the third phase, they were also requested not to mimic the motifs but to arrange and sophisticate them as their original choreographic works. After rehearsal, their short dance pieces were performed by themselves in front of a video camera one by one. At the end of the experiments, they were requested to complete a questionnaire. The experiment took about 90 minutes for each group, including the instructions.

4.2 Results and Discussion

Although the examinees were given only short and simple instructions lasting about 10 minutes, every examinee could master the system readily and smoothly with both the notebook PC version and the tablet version. They all completed the creation of their original short dance pieces within 90 minutes. The duration of the pieces varied from 13 to 53 seconds, with an average of 25 seconds. The number of motifs they connected varied from 5 to 10, with an average of 7.

In the questionnaire, the examinees were asked to answer about the effectiveness of the system for "understanding of dance movements" and "creation of contemporary dance" (Umino, Soga and Hirayama, 2014). The examinees were requested to choose from four options, and Table 2 shows the number of replies for each option.

Table 2: Students' ratings of BMSS.

	Understanding of movement		Creation of dance	
	Notebook PC	Tablet	Notebook PC	Tablet
effective enough	3	5	6	14
effective if modified	5	10	0	4
not so effective	0	0	0	0
don't know	0	3	2	0

In terms of understanding movements, 23 out of the 26 examinees chose either "effective enough" or "effective if modified." Three Japanese students with the tablet version chose "don't know" and commented similarly that watching 3D animation without practice was insufficient to understand the movements. However, no one chose "not so effective." The results suggest that the examinees were satisfied with the system as a useful tool for learning movements. In terms of contemporary dance creation, 20 examinees chose "effective enough." Two Japanese students with the notebook PC version chose "don't know," but all of the students with the tablet version chose either "effective enough" or "effective if modified." These results suggest that the examinees were satisfied with the system as a useful tool for creating new movements.

The free descriptions by the 26 examinees in the questionnaires were analyzed in detail. First, to the open question "Please describe in detail any choreography sequences that you made using BMSS that were unexpected and outside of your usual movement vocabulary," all 26 examinees described what they found as new movements of contemporary dance for themselves. Several typical responses (JP denotes Japanese, US denotes American) were elicited: "When I created movements which looked interesting on the display, I noticed which body-part I usually tend to ignore" (JP); "Jumping from being in a deep lunge/one knee on the floor was unexpected" (US); "Having the foot shake at the end of the leg touch was way outside of my movement vocabulary" (US).

Second, to the open question "What did you learn about creating contemporary dance choreography through this experiment?", all of the examinees described something they had learned. Furthermore, 22 out of the 26 examinees reported that they learned a novel choreographic method of contemporary dance. Several typical responses were gathered: "I could think of dance movements as combinations of simple movements" (JP); "I realized that combination and permutation of movements gave me original choreographies infinitely" (JP); "I learned that creating movements by layering different elements or body parts can be very effective" (US). The responses proved that the examinees learned the idea of analytic-synthetic choreography, although it had not been explained explicitly during the experiments. Although four examinees did not describe a new choreographic method expressly, they nevertheless pulled off creation using the analytic-synthetic way unconsciously.

After analyzing the free descriptions by the students in the questionnaires, it is reasonable to conclude that they could discover both new movements and new choreographic skills through the learning methodology based on analytic-synthetic choreography. Finally, we received positive answers to all five of the questions proposed in 4.1. A comparison between the notebook PC version and the tablet version was clarified in another paper (Umino, Soga and Hirayama, 2013).

5. Conclusion

Body-part Motion Synthesis System (BMSS) has been developed for learning choreographic skills in contemporary dance. The software is designed to actualize analytic-synthetic choreography. As a result of experiments, we verified that the system's usability is acceptable in terms of easy operability, students' satisfaction, discovery of new movements, and learning a new choreographic method.

At the beginning of this paper, the authors mentioned the difficulty of learning somatic and artistic skills with a computer. Regarding the somatic skills of dance, students will have learned new movements through the second and third phases of the proposed methodology. Regarding the artistic skills of dance, students will have learned analytic-synthetic choreography by themselves through this methodology. In conclusion, the methodology is effective for learning both somatic skills and artistic skills of contemporary dance.

Through the experiments, we received a lot of responses about how the examinees wanted to improve BMSS. In future work, we intend to improve it after reviewing these responses. For example, we plan to augment the user interface so that the system can promote learning more effectively.

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