

# HCI challenges in Dance Education

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## ABSTRACT

Dance learning is by nature multimodal, while dance practice presents a wide diversity across genres and contexts. Choreography and artistic contemporary dance performances have been using interactive technologies to support their creative process for several decades. Nevertheless the use of interactive technologies to support dance learning and education is still relatively immature and raises many challenges and interesting questions when it comes to choosing the appropriate human computer interaction methods. In this paper, we present the characteristics of dance teaching and learning in relation to interactive technology and we highlight the points/feedback that dance, as a field of mastering expressive movement, can bring to the design of whole-body interaction experiences.

## Author Keywords

HCI; whole-body interaction; digital learning; dance; education;

## ACM Classification Keywords

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## INTRODUCTION

The first question we need to address in a user-centered design approach is “who are the user groups” of the technological system we are developing. Dance practice presents a wide diversity across genres and contexts. Dance varies from social physical activity and intangible cultural heritage expression (within the wide range of folk, traditional and ethnic), to creative performing art. This means that learning objectives in dance include a wide range from improving kinetic and sensor motor skills, to cultivating musicality, improvisation and creative abilities, to cognitive analytical skills and enriching concrete knowledge about the technique and context of the dance.

## INTERACTIVE TECHNOLOGIES FOR DANCE

Having said this, interfaces for dance education might vary from traditional screen tutorials, to innovative multi-sensory representation, and from whole-body interaction to Augmented and Virtual Reality Environments [2,5,6].

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Interactive technologies have been widely used in the context of artistic performance and creativity [1]. Co-operation-co-creation with practitioners is very important. Merce Cunningham and William Forsythe, are two of the well known choreographers who have not only used technologies to support the choreographing process but are considered founders of projects/tools such as LifeForms [12], Improvisation Technologies [9], Motion Bank [11] and Synchronous Objects [18]. Although “economy of movement” (meaning to move in an efficient, functional and simple, non-stylized manner), might be one of the principles in some approaches to dance techniques, movement in dance does not play a functional or a symbolic role. The concept of usability or functionality of the interface has to be re-thought. Usability implies an interface which is –easy to use- in order to achieve something, but here the movement –as opposed to gesture- based interaction-is not a way to communicate a specific message or task, it is the movement itself that is our main focus of interest.

## DANCE LEARNING

Dance learning also can take place in informal settings as well as in formal dance education institutions. Systematic learning can be hard, demanding and also requires the development of critical, analytical skills on one’s own movement and knowledge. Dance is also a field of mastering movement literacy and creativity. Different techniques apply different learning objectives, teaching approaches, and often philosophies on movement. On the other hand, if there is one field where education and learning needs to be continuous this is the field of dance. There is no advanced or professional dancer who quits practicing, attending classes and seminars in daily or frequent basis if she/he wants to remain active.

## Teaching approaches

Although for physical education in general several models have been applied [7], in dance we can summarize the following teaching approaches, which are also described in the first outcomes of WhoLoDancE project [20]:

1. Mimesis – imitation/copying (the teacher is teaching the student a specific movement or sequence of movements);
2. Generative – the teacher gives the student an exercise/phrase/sequence as a starting point to achieve technical and creative goals;
3. Reflexive – the student is given a movement task/image/to work with, improvising without trying to

achieve a specific phrase/sequence and the teacher provides feedback.

4. Traditional method (command style teaching), where the teacher makes all the decisions and the learner follows these decisions. The method requires precision and accuracy of performance.

#### **Differnet teaching aproches cultivate different motor skills**

The different teaching styles are usually adopted by specific practices, which sometimes have to do with the tradition or culture in the dance genre rather than a deliberate choice. Nevertheless, different teaching approaches can cultivate different motor, cognitive and creative skills. Dance learning requires the development of both open and closed skills. When practicing in studio-or class specific sequences or choreographies the dancer performs in a highly predictable environment, and doesn't have to consider external, environmental changes and challenges (closed), while in improvisation, dancing with partner, or a group, or performing in front of the audience the dancer is challenged to move in an unpredictable environment (open). Also depending on the context the dancer can be internally paced, e.g., if he improvises alone or externally paced e.g., when have to follow the music or a dance partner. The last two examples (open vs. closed and internally vs. externally paced) inspire different learning scenarios for interactions.

#### **Dance Learning and Technology**

In the field of education for dance, recent research question recent models of mimicking a perfect movement model to achieve the required performance. The "demonstration-reproduction" mode is not the only approach or always the best choice for successful learning, suggest some authors in the direction of "seeing improves doing –and doing improves seeing" [7]. In this traditional of "see and do" approach the assumption is that dance should rely mainly in *Active experimentation and Concrete experience* (Kolbe's learning cycle). On the other hand dance as any other complex field of learning should cover all the learning cycle, including developing the ability of both *Reflective Observation* and *Abstract Conceptualization*. The notion of the "thinking body" is not new in dance pedagogy and choreography. The results of an assignment on Merce Cunningham work in combination with motion capturing in an experiment have led to the following conclusion. By analyzing movement from both scientific and aesthetic perspectives, students can gain a deeper appreciation of why people move their muscles and bones in a particular fashion [17]. In addition, since dance is an abstract that exist in the memory, teaching the concepts relating to form can be much enhanced using technology [15].

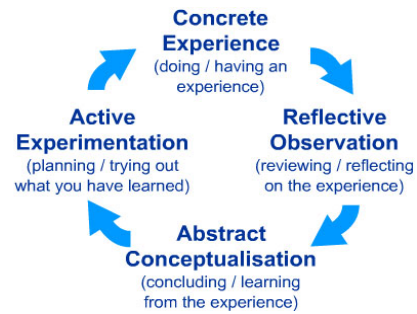


Figure 1-Kolbe's learning cycle<sup>i</sup>

#### **SPECIFIC CHALLENGES**

In this section we describe some of the major challenges of designing and developing HCI experiences for dance education.

- Terminology - how to avoid verbal descriptions ambiguities
- The movement has no goal, it is itself the goal!
- Creating meaningful scenarios - why bring the digital medium in?
- Aesthetics issues of movement and human body representation

#### **Terminology –how to avoid verbal descriptions ambiguities**

Starting from the basics, a simpler interface for dance education would be a screen-based traditional environment for searching; browsing dance content (video, image, audio, text etc) and here comes the first issue: what is the appropriate language to communicate non-verbal communication? "Match between the system and real world" the second principle of Nielsen would suggest: "The system should speak the user's language, with words, phrases and concepts familiar to the user, rather than system oriented terms"[14]. When it comes to dance there is no standardized language or terminology across dance genres and learning practices. On top of this many choreographers and dance practitioners use their own idiosyncratic vocabularies. These individual dancing cultures informally define the movement units as meaningful segments or content components in each case. How therefore could we search a repository of dance content using "the user's language" on movement? Two possible solutions: a) Develop context specific vocabularies; b) get rid of language and verbal descriptions. If we want to design an interface that speaks the user's language, we should realize that in this case the "language" is the movement itself. A repository as described above ideally would be searched and browsed through movement.

#### **The movement has no goal, it is the goal!**

In addition, whole-body interaction in dance is different from gesture-based interaction. In dance, with an exception of very specific genres, the movement does not convey a symbolic message. And neither does it normally consist of movement units with clear start and ending points, to serve

a specific task or goal, e.g., pressing a key or catching a ball. This aspect of continuity, which is very clear in the case of dance (unless it is required for a choreography to imitate a more “robotic” or “fragmented” quality), highlights a mode of interaction, is important to other aspects of life as well. In addition, the diversity of contexts in dance provides a very wide range of movements and motor skills. For example, in contrary to some other sports and physical activities, most of dance techniques require mastering both *fine* i.e., using smaller muscles to achieve precision e.g., precise hand or finger movements, and *gross* motor skills, i.e., using larger muscle groups or parts of the body as a whole e.g., running, or jumping. Gesture based interaction, apart from conveying particular meaning, is based on *Discrete* motor skills, i.e., movement units that have clear start and ending point, whereas in physical activity in general and more specifically in dance discrete motor skill are only one option, e.g., doing a pirouette, among many. This is the case when one needs to master one specific move or step usually at early stages of learning. Dance, on the other hand depending again on the style and context is a combination of *Series* or *Sequential* and *Continuous* skill. For example, in choreography, a combination of specific motives (sequential) vs. dancing or improvising with no clear, discrete movement units. Whilst unpredictability, fluency and freedom of movement are some principles in contemporary dance, at the same time economy and efficiency, as well as clarity of movement are required as well. Scenarios of using interactive technologies to explore the movement as functional, goal oriented tasks in a gamified, creative, personal or collective experience [5,19] opens new perspectives for both educational, choreography approaches and HCI. In addition, since dance inspires many whole body interaction scenarios but not gesture interactions in the manner of communicating specific meaning it adds another argument of how “natural are natural user interfaces” a question been posed by D. Norman [13] but also reflected in artistic setting [15]. As the video of Privieux implies, gesture based interaction, actually imposes stillness, discrete movements, and requires from the user a very specific and restricted choreography to achieve his goal.

#### **Meaningful scenarios of use**

In other fields of “book” education (or even presentation) of technology and digital interaction brings the element of entertainment, creativity, and enhances the experience through engagement. Dance is by nature, multimodal, a whole-body activity, by itself considered entertaining. In addition, although props are used in specific dance styles, in general it is one of the artistic forms that require nothing but the human body and space. Bringing a new medium in the studio, on the body of the learner can be considered a significant intervention in the kinesthetic experience. Although dance requires a combination of sensor motor and cognitive skills, which can be supported not only by the kinesthetic, but also the visual and audio channels, the

design must be focused on what the digital interaction can add to the learning experience, without shifting the weight to the analytical skills e.g. through a visual channel. Finding the impact of the used digital interaction for each context is the key. Going back again to the basic ten Nielsen’s principles of usability the solution lies in “bringing analogies from real world examples”[14]. This is achievable through the close collaboration-if not co-designing sessions between dance educators, practitioners and interaction designers. This point creates a challenge for designing “seamless” [4] and “transparent” technologies [3].

#### **Aesthetics of the digital intervenes to the aesthetics of the dance**

Although the visual quality of a 3D model, VR environment or avatar construction is a technically challenging issue, the decision of what representation is appropriate for the transmission of the movement is key. Every dance genre and style usually brings with (consciously or not) a whole culture, and philosophy on the perception of the body and its fragmentation. For example, in classical ballet, there are the limbs, legs, arms, the torso, the head, but traditionally the dancer does not think about the spine, hips, and abdomen. In folk chain and round dances all the moves are in the feet, since dancers hold each other’s hands. Arm movements are very limited and restricted; the costume imposes a quality of movement and reflects a body image of a whole area and era. In contemporary dance, the fragmentation of the body is challenged, as it is not fixed. Dancers are asked to be innovative in their movement, and perception of the body. This perception varies from biomechanical descriptions to poetic imagery. Dance as a performance creative art raises aesthetical, philosophical and perhaps political questions. Having all this variety of perspective creates the question what is the appropriate avatar or human body representation to teach dance in virtual environment? Do we need to convey these perspectives or leave some parts to the imagination of the user-student? How realistic do we need to be in the representation of the human-body, and how this implies a body image or in a worst-case, a stereotype? It is true, however, that these issues existed before the use of avatars, thus one can claim that technology here can play a powerful role. Using stick figures side to side with anatomical details about one’s movement, or abstract visualization can transmit the quality or the essence of the movement. Using abstract visualization as body extensions [1], sonification or virtual landscapes [6] opens new perspectives on perceiving movement and explorations through various scenarios.

#### **HCI - AN ANALOGY TO HHI**

In the following section we employ an analogy of Human Computer Interaction to Human – Human Interaction to identify the core aspects of interactivity for dance learning environments. In particular a dance learning scenario can be viewed as an interaction dialogue between the dance teacher and the student. Learning objectives and teaching

approaches, as the one described in previous section, in combination with specific categories of motor skills, can define a mode and degree of intervention. The four factors are the following:

- Way of intervention
- Frequency of intervention /Timing /Initiative
- Continuous vs. Discrete
- Correction vs. Reflection

**Way of intervention.** The way of intervention provides the answer to what is the modality chosen (Audio, Visual, Haptic, etc) to give the required feedback to the student. The choice depends on the learning objective and scenario itself, as well as the learning style of the student (audio, visual, kinesthetic, multisensory), but it is independent of the teaching style (mimetic, traditional, reflexive, or generative)

**Frequency of intervention /Timing /Initiative.** This parameter defines how frequently the teacher intervenes or not to provide feedback to the dancing student. In the traditional and mimetic teaching styles, in contrary to the reflexive and generative the learning experiences are basically lead by the teacher, thus the interaction is mainly initiated by the system, which asks the student to do something in a very particular way.

**Continuous vs. Discrete/asynchronous.** Another point that we need to decide for the interaction is whether the feedback is continuous or discrete. For example, sonifying one's movement in real time is a way to provide feedback continuously, without interrupting the sequential or continuous skill of the dancer. In the discrete mode of interaction, the user does a movement or a short sequence and the system replies with feedback.

**Correction vs. Reflection.** This parameter differentiates the feedback given by the teacher (or system), depending on the inclusion of semantic meaning. Correction, which occurs in the traditional model, means that the system has set a codification to tell you how close you are to the "right" movement or manner of movement. In Reflection, however, the feedback does not imply "right or wrong" semantics; the system (or teacher) just provides open feedback on what you do. This is usually the case when the Reflexive or Generative teaching approach is applied.

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<sup>i</sup> <http://www.simplypsychology.org/learning-kolb.html>