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Exergames ‘as a teacher’ of movement education: exploring knowing in moving when playing dance games in Physical Education

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Abstract

Background: A fundamental dimension of school physical education (PE) is arguably movement and movement activities. However, there is a lack of discussion in the context of PE regarding what can be called the capability to move in terms of coordinative abilities, body consciousness and educating bodily senses.

Purpose: This article explores and articulates what there is to know, from the mover’s perspective, when knowing how to move in specific ways when playing exergames (dance games). Taking different ways of moving as expressing different ways of knowing as a point of departure, the following questions are the focus of this article: i) How do students move when imitating movements in a dance game, and what different ways of knowing the movements can be described in the student group? ii) What aspects of the movements are discerned simultaneously through the different ways of knowing the movements? and iii) What aspects seem critical for the students to discern and experience in order to know the movements in as complex a way as possible?

Design and analysis: The theoretical point of departure concerns an epistemological perspective on the capability to move as *knowing how* with no distinction between

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physical and mental skills, and also *knowing* as experiencing aspects of something to know. The data in this study comprises video recordings of students playing Nintendo Wii dance games in PE lessons in a compulsory school (for children aged between 7 and 16) in a small Swedish town. There were three PE lessons with four different stations, of which one was Nintendo Wii dance games (*Just Dance 1 and 2*). In total, the videoed material covers three 60-minute PE lessons, recorded during the autumn of 2012 and in which just over twenty students participated. In the study, we have used video observation as a data collection method. Jordan and Henderson (1995, 51) maintain that video observation removes the gap between ‘what people say they do and what they, in fact, do’. To conduct a systematic and thorough analysis of how the students experienced the avatar’s movements, we looked for moments where all the students and the avatar could be simultaneously observed. Two video sequences were chosen, showing four students imitating two distinct and defined movements which constituted the basis for a phenomenographic analysis.

Conclusion: The result of the phenomenographic analysis shows different ways of knowing the movements as well as what aspects are discerned and experienced simultaneously by the students. In other words, these aspects also describe knowing in terms of discerning, discriminating and differentiating aspects of ways of moving. By examining a certain exergame’s role ‘as a teacher’, we have emphasized the capability to move, from the mover’s perspective, as an intrinsic educational goal of PE while highlighting the need for systematically planning movement education.

Abstract for practitioners

Background: There is a lack of discussion in the context of PE regarding the capability to move in terms of, for example, coordinative abilities and body consciousness.

Purpose: This article explores what there is to know when knowing movements in dance exergames.

Design and analysis: The theoretical point of departure concerns a perspective on the capability to move as *knowing how* with no distinction between physical and mental skills, and also *knowing* as experiencing aspects of something to know. Video observation has been used for data collection and phenomenography for analyzing the data.

Conclusion: The result shows different ways of knowing movements as well as what aspects are discerned and experienced. By examining a certain exergame's role 'as a teacher', we have emphasized the capability to move as an intrinsic educational goal of PE while highlighting the need for systematically planning movement education.

Keywords: capability to move, exergames, dance, movement education, knowing in moving

A fundamental dimension of school physical education (PE) is arguably movement and movement activities. However, there is a lack of discussion in the context of PE regarding what can be called the capability to move in terms of coordinative abilities, body consciousness and educating bodily senses (Larsson, Redelius, and Fagrell 2011; Redelius, Fagrell, and Larsson 2009; Evans 2004; Shusterman 2004; Kirk 2010; Tinning 2010). This paper contributes to this discussion with regard to what the capability to move, or in other words, *knowing in moving*, can mean, and how this knowing can be developed in PE when introducing new artefacts. Our study focuses on the growing use of exergames as a form of PE teaching aid (Quennerstedt et al. 2014) and subsequently explores their potential contribution to developing students' knowing in moving. Many of these games involve imitating movements, and one aim, according to PE teachers, of using the games in PE, apart from fighting obesity and increasing students' fitness levels, is their potential contribution to movement skill acquisition (Meckbach et al. 2013).

Computer games, known as exergames, have been introduced in PE as a form of teaching aid in several countries (Quennerstedt et al. 2014; Staiano and Calvert 2011). An emerging body of research is showing an interest in these games and their role in the teaching and learning of PE. This body of research has focused, for example, on the games' role as an 'activity instructor', thus raising students' physical activity levels and improving the fitness of young people (Ennis 2006, 2013; Quennerstedt et al. 2014; Vander Schee and Boyles 2010; Biddiss and Irwin 2010). Another area of interest has been their role as a 'health educator' (Papastergiou 2009; Öhman et al. 2014) in terms of the games' implicit influences on what young people might learn about their bodies and themselves. Research shows, for example, that these games have 'a number of potentially harmful consequences' (Öhman et al. 2014, 1), supporting the idea of 'healthism' and thus cultivating a perspective on health which reflects the young, slender and beautiful body as expressing a healthy citizen (Öhman et al. 2014). Exergames 'as a supervisor', monitoring students' heart rates, BMI scores and weight loss, thus violating their integrity, has also been explored and discussed (Lupton 2014). Further, Ennis (2013, 156) argues for the games' potential role as 'fitness teachers', thus enhancing students' understanding of the effects of exercising and creating exercise programmes.

What then about learning movement? How can the games, with a focus on dance games, be regarded as a teacher of movement education, that is, with an educational aim of enhancing students' capability to move? Thus, teaching is in this paper regarded as a matter of planning for, and providing learning experiences as Light and Kentel (2015) puts it, "that optimize and deepen understanding for learners" (386).

Research on exergaming in PE has focused on learning fundamental movement skills, such as balance, agility, coordination and laterality (Sheehan and Katz 2010), object control skills (Vernadakis, Papastergiou, and Antoniou 2015) and motor skill learning in relation to the

software design of exergames (Di Tore and Raiola 2012). In their review of research, Di Tore and Raiola conclude that research on the effectiveness of exergames with regard to motor skill learning seems lacking and therefore they aim at investigating this issue with a special interest in the software programming. Research has also explored what kind of movement qualities students in PE lessons use when playing the games (Meckbach et al. 2014) and the findings suggest that for dance games, students use a wider variety of movement qualities in relation to sport and exercise games. In addition to this finding, the study provides a pathway to articulating qualities in moving rather than investigating, for example, physiological effects and energy expenditure. However, as Ennis (2013) concludes, exergaming in relation to ‘content mastery’ (155), in terms of, for instance, movement skills and problem solving, has not been examined sufficiently.

There is a need to further investigate whether and how exergames could provide learning possibilities in the fields of movement education and the capability to move. In our view, the research on exergames’ contribution to movement skill acquisition and to the use of movement qualities does not take into account the mover’s perspective in terms of what it means to know a movement, which this paper will focus on.

This paper aims to explore and articulate what there is to know, from the mover’s perspective, when knowing how to move in specific ways when playing dance exergames. Firstly, we will examine, through a phenomenographic analysis (Marton 1981; Pang 2003), two examples of a detailed investigation of four students’ different ways of knowing two dance movements when playing dance exergames. Secondly, we will use these examples to discuss, based on a phenomenographic approach to knowing and learning, necessary conditions for developing

students' capability to move in terms of knowing in moving and the games' potential contribution as a teacher.

Taking different ways of moving as expressing different ways of knowing as a point of departure, we have considered the following questions more thoroughly: i) How do students move when imitating movements in a dance game, and what different ways of knowing the movements can be described in the student group? ii) What aspects of the movements are discerned simultaneously through the different ways of knowing the movements? and iii) What aspects seem critical for the students to discern and experience in order to know the movements in as complex a way as possible?

Theoretical point of departure

This study's theoretical point of departure concerns an epistemological perspective on the capability to move as practical knowledge in terms of *knowing* with no distinction between physical and mental skills as is common in the area of motor learning and control (Nyberg and Carlgren 2014). Also, we consider knowing a capability to simultaneously be aware of aspects of what is known, which is coherent with a phenomenographic approach to the meaning of knowing, or in other words, what it takes for someone to know something. This will be developed below.

We regard different ways of moving as different ways of *knowing* a movement. In 'marrying' the concept of Gilbert Ryle's *knowing how* (1949) – not separating physical skills from mental skills – with the notion of *tacit knowing* elaborated by Michael Polanyi (1962, 1966, 1969), the knowing involved in knowing a movement can be conceived of as including mental as well as physical skills, and knowing a certain way of moving includes both understanding, referring to theoretical knowledge, and mastering, referring to practical knowledge (Polanyi 1969, 126).

Conceiving of voluntary human movement as intelligent actions, Ryle (2009, 18) argues that ‘the intellectualist legend is false and that when we describe a performance as intelligent, this does not entail the double operation of considering and executing’. The Cartesian dualism, which Ryle calls ‘the intellectualist legend’ (26), inherits the belief in considering or thinking as a coordinating superior regiment. In contrast to this, Ryle (2009, 26) argues that thinking is a practice (an action among many others performed by a human being) which itself could be performed intelligently or not. Knowing is rather a ‘disposition to act’ (22), developed through being and acting in the world. Knowing as such can thus not be studied; it is expressed through actions. Taking this standpoint, we can conceive of moving (purposefully) in different ways as expressions of knowing.

However, the kind of knowing involved in practical skills such as, for instance, dancing is not easily articulated since this kind of knowing is to a large extent tacit. Polanyi’s well-known example (1969) of the difficulties of articulating what there is to know when riding a bike is similar to the problems of describing what there is to know when knowing a dance movement. A technical description of how the movement should be performed, using rules of physics and biomechanics, is not sufficient to tell us the meaning of the knowing involved when riding a bike or performing a dance movement because there is a tacit dimension involved and thus ‘a number of factors to be taken into account in practice which are left out in the formulation of this rule’ (Polanyi 1969, 50). All knowledge, Polanyi argues, is rooted in practical and personal experience forming a tacit dimension which grows and develops in the context in which we are dwelling. This kind of personal and tacit knowledge constitutes a background (e.g. the embodied awareness of how to keep your balance while riding a bike) on which we rely while relating to issues in the foreground (e.g. finding a safe way down a steep). The capability to

move in terms of knowing specific dance movements is in this study regarded as in line with Ryle's and Polanyi's notions of *knowing how* and *knowing*; as personal and tacit, including both understanding and mastering, thus also challenging the distinction between mental and physical skills. A coherent approach to knowing is provided through phenomenography, which describes knowing as being aware of different phenomena in the world. The phenomenographic approach, as elaborated below, will therefore be used to analyze, describe and articulate the tacit knowing involved in dancing.

A phenomenographic approach

To unpack the tacit as well as explicit aspects of knowing, we need a method of analyzing which considers the knowing expressed through acting, in this case dancing. A method to systematically investigate different ways of understanding, something to be known (a phenomenon), for example a specific skill, such as carrying out a movement, is to conduct a phenomenographic analysis of the different ways in which students experience the phenomenon. Phenomenography emerged in the early 1970s from empirical studies of learning among university students in Sweden (Marton 1994, 4424). The findings of these studies, drawn on interviews, were that students seemed to experience different phenomena (in this case how the content in a text was understood) in a limited number of qualitatively different ways. The different ways of understanding were also described as different ways in which people 'experience, perceive, apprehend, understand or conceptualize the world around them' (Marton 1994, 4425).

A phenomenographic approach to knowing means a capability to discern and experience different phenomena in the world, and learning thus means a change in one's capability to discern and experience a phenomenon (Pang 2003, 153). It is important to note here that all

these words used for describing how people experience something do not necessarily indicate mental or cognitive activities. Rather, they mean a way of being aware of something (Marton 1994, 4426) irrespective of focusing on conceptual or sense-related features (Marton and Pong 2005, 336). Being aware of your own way of dancing, for example your posture, how your arms simultaneously move, the degree of stiffness or tenderness of your neck and shoulders, does not necessarily mean that you are capable of explicating your awareness. Rather, it is a specific way of knowing embedded in your body. This kind of knowing is neither merely ‘mental’ nor ‘physical’ but a ‘marriage’ of these (Ryle 1949, 2009); largely tacit (Polanyi 1969) and a matter of being aware of certain aspects of something to be known (Pang 2003).

The advantage of phenomenography, from an educational point of view, is that the outcome of a phenomenographic analysis can identify in a group of students different ways of knowing something to be known, from the students’ point of view. This, in turn, contributes to a deeper understanding of what is expected to be known as an awareness of, and taking into account, the learners’ different ways of knowing (or experiencing, understanding, perceiving, comprehending or conceptualizing as Marton [1994, 4426] also expresses it). The different ways of knowing also provide a picture of what different meaning (e.g. experiencing a movement ‘as waving in the air, slightly bouncing’ or ‘as waving with the hand’) the learners seem to ascribe, e.g. a new movement to be learnt. Furthermore, a phenomenographic analysis can identify what aspects of the movement are discerned and experienced by the movers. In other words, a more differentiated and nuanced picture of what there is to know when knowing the movement.

The insight into what learners are expected to know as well as how they know this from the start is one of the most significant aspects of teaching and learning (Marton and Booth 2000, 225; Dewey and Bentley 1949). This is thus a powerful starting point when planning teaching

and learning, for example the capability to move through learning movements with the aim of mastering them in as complex a way as possible. Also, as it is used in this study, it will also provide a picture of a particular exergame's role 'as a teacher'.

To discuss a potential further development of students' knowing in relation to exergames' role 'as a teacher', we will use, as Pang (2003) puts it, 'the new phenomenography' (also known as the variation theory of learning), which is developed out of phenomenography. According to this theory, a necessary condition for discerning and experiencing something is to experience a variation in that dimension (Marton and Pang 2006) which requires 'a kind of temporal integration, a simultaneous awareness of what we are experiencing and what we have experienced in the past' (Marton and Tsui 2004, 31). Runesson (2006) gives an example of what characterizes an expert vis-à-vis an amateur concerning the knowing of wine:

For instance, when an expert characterizes the taste of a wine, certain characteristics are differentiated that are not discerned by a novice. The novice is unable to discern these features of the wine, and therefore experiences the wine differently. (Runesson 2006, 401)

Being aware of one's own way of walking, for example as Sheets-Johnston (2011) exemplifies: "[...] the swiftness or slowness of movement, its constrictedness or openness, its tensional tightness or looseness and more." (49), may be difficult if everyone else walks in the same way and if one has always walked in the same way. There will be no opportunities for experiencing a variation of aspects of walking. To discern and experience significant aspects of dancing, it is a necessary condition to experience, for instance, a certain speed in relation to moving slower and faster. In line with this, the consistency of how the movements are carried out (e.g. flaccid or firm) as well as the use of space must be experienced with regard to other consistencies: stiffly, softly, etc., as well as other ways of using the space. In other words, an opportunity to experience

contrasting speed, consistency and the use of space must be offered to students (Nyberg and Carlgren 2014).

Methodology

The study presented in this article is part of a four-year project funded by the Swedish Research Council with the aim to investigate the meaning-making regarding the body, physical activity and health which takes place in young peoples' playing of exergames.

The data used in this study comprises video recordings of students playing Nintendo Wii dance games in PE lessons in a compulsory school in a small Swedish town. There were three PE lessons consisting of four different stations, of which one was Nintendo Wii dance games (*Just Dance 1*). The students could choose freely between the stations. In total, the videoed material covers three 60-minute PE lessons, recorded during the autumn of 2012 and in which just over twenty students participated.

In this study, we have used video observation as a data collection method. Jordan and Henderson (1995, 51) maintain that video observation removes the gap between 'what people say they do and what they, in fact, do'. Since we were interested in how the students moved when playing Wii dance games, video was a suitable tool to employ. The videoed material also made it possible to repeatedly view the students in order to systematically analyze their ways of moving when playing a dance game.

The study was conducted in accordance with the Act concerning the Ethical Review of Research Involving Humans (SFS 2003:460) and the students and their parents/guardians were informed of its aims and method. The students as well as their parents/guardians have given permission

for the filming. We also made it clear that at any point the students could choose not to be filmed. All the involved participants consented to being filmed for the study.

When playing the dance games, two to four players stand in front of the TV screen, each holding a hand controller in one hand. The idea of the games is to mimic the various on-screen dance steps. The dance exergames were selected based on the kinds of movements to be performed as well as the surrounding conditions. In relation to, for example, the snowboard game, the dance movements are performed on the ground, which provides similar conditions for the students, whereas the movements in the snowboard game are performed virtually on a snowboard on a slope, which is not the case for the students. Additionally, the dance movements involve all body parts, thus constituting a complexity which we assumed could produce more obvious differences among the students' ways of moving when replicating the movements.

To conduct a systematic and thorough analysis of how the students experienced the avatar's movements, we looked for moments where all the students and the avatar could be simultaneously observed. Two video sequences were chosen, showing four students imitating two distinct and defined movements which constituted the basis for the phenomenographic analysis outlined below.

Analysis

Usually, a phenomenographic analysis draws on in-depth interviews, although analyzing actions is also a passable way (Nyberg and Carlgren 2014). In this study, however, the students' different ways of moving when replicating the avatar's on-screen way of moving were considered their ways of knowing that particular way of moving, and thus ways of moving formed the unit of analysis.

To analyze differences in ways of knowing the avatar's way of moving, each student's way of moving, as well as the avatar's, first were observed and described. In doing this, we had to carefully examine, distinguish and verbally describe what we could see. A significant difference between transcribing ways of moving and transcribing ways of speech is, as we see it, the lack of a universally recognized way of describing different ways of moving. In the area of dance, for example, there are words for certain movements and ways of moving, and in the area of gymnastics, there are others but the vocabulary in these areas is quite specific and needs, in turn, further explanations. So is also the case regarding several different coding and notation systems of body actions e.g. Labanotation (Laban, 1956; Hutchinson, 1954; Harrigan, 2005) and an extensive body of coding systems developed in the area of nonverbal behavior research (Dael, Mortillaro and Scherer, 2012). There are, of course, ways to describe various joint movements anatomically, such as extension, flexion, pronation, supination, abduction and adduction. However, if one were to use this way of describing a complex movement, such as the dance movements in the exergames, it may result in extremely extensive and atomistic descriptions, and it would not provide any qualitative differences in, and nuances of, ways of moving. For example, knee joint flexion can be performed in many different ways: with various degrees of tenseness and ranges of motion, speed and acceleration (using eccentric power or not). This knee flexion may also be simultaneous with, just before or after any movement of the elbow (or other joints), which, in turn, can be performed in all the different knee flexions. We judged that such a description of each student's way of moving would not be fruitful for analyzing differences in the student group's ways of knowing the movement. However, since mere words cannot replace the filmed ways of moving, these transcriptions were regarded as complementary to the video recordings.

The next step in the phenomenographic analysis was to identify common features of differences in the students' ways of moving. For example, regarding the first movement, 'hammering with a bodily recoil', we considered two areas significant in identifying differences, namely i) *the pounding with the elbow and the simultaneous bodily recoil*, and ii) *how one's whole body engages in the way of moving*. Regarding the second movement, 'tilted, bouncing and pressing', we focused on differences in the areas of i) *pressing with the hands*, and ii) *the bouncing*. The reason for choosing these areas was, in our view, that they represented significant features of the movements. However, we are well aware of the possibility of choosing other areas of significance.

The findings of the analysis were based mainly on the differences in these areas and resulted in three categories of description respectively. The next step was to name these categories in such a way that they metaphorically mirrored a possible way of experiencing the movements 'as something'. This naming could also be described as a way of naming the possible meaning the learners ascribe to the avatar's particular way of moving. These possible meanings, or ways of experiencing will vary depending on the group of learners. In a phenomenographic approach, this aspect is referred to as the referential aspect (Marton 1981, 1994; Marton and Pong 2005; Marton and Booth 2000).

The categories of description were further studied and analyzed to identify what aspects seemed to be discerned and experienced by those who experienced the way of moving described as a category. These aspects are referred to as the structural aspects of the experienced phenomena (Marton 1981, 1994; Marton and Pong 2005; Marton and Booth 2000). Structural aspects, important for learners to discern in order to experience the object of learning in a more complex and powerful way, are called critical aspects. This structure of awareness constitutes a starting point for planning teaching and learning; knowing is about discerning, discriminating and

differentiating aspects of a phenomenon (Runesson 2006, 401). Hence, according to the new phenomenography, the students should be given the opportunity to experience a variation of critical aspects.

Below we present the descriptions of the avatar's way of moving as well as each student's when imitating the avatar. The four students stand two by two next to each other in front of the screen showing the avatar dancing. All the students hold the controller in their right hand. The avatar's way of moving is described from the students' perspective, thus laterally reversed. Below (Table 1) we present the descriptions of the avatar's way of moving when performing what we call *hammering with bodily recoil* followed by descriptions of the students' ways of moving. These descriptions, together with the video material, therefore, laid the foundation for the phenomenographic analyses.

Movement no. 1. Hammering with bodily recoil	
The mover	Description of ways of moving
Avatar	Standing with the feet wide apart, tilted to the left with the weight on the left. The knees are bent, the left more than the right. The right arm is up in the air, the elbow bent, pointing to the side in line with the shoulder, and the left hand clapping on the left leg. Simultaneously, the elbow is hammering to the side, following the pace of the music while the rest of the body, on each hammering, seems to recoil.
Student 1	Standing upright with the feet slightly apart. Initially, the left arm is hanging but after a while it is bent and held still in front of the belly. The right arm is raised and bent at the same time as the hand and the

	lower arm are pumping back and forth towards the screen. After a while, the lower arm instead goes back and forth like a 'windscreen wiper', irrespective of the pace of the music. The whole body slightly moves to the pace of the music.
Student 2	Standing upright with the feet somewhat apart, with slightly more weight on the left leg. The left arm is hanging relaxed. The right arm is raised and bent and the lower arm is moving back and forth in the direction of the screen like a whiplash.
Student 3	Standing upright with the feet slightly apart, with more weight on the left leg. The left arm is hanging relaxed. The right arm is raised and bent and the lower arm is waving back and forth like a 'windscreen wiper'. The right leg slightly bounces to the pace of the music.
Student 4	Standing upright with the feet together. The left arm is hanging relaxed. The right arm is raised and bent in front of the belly, and the lower arm is moving back and forth in the direction of the screen and to the pace of the music.

Table 1: Description of hammering with bodily recoil

Beneath (Table 2) we present the descriptions of the avatar's way of moving when performing what we call *tilted*, *bouncing* and *pressing* followed by descriptions of the students' ways of moving when imitating the on-screen avatar.

Movement no. 2. Tilted, bouncing and pressing	
The mover	Description of ways of moving
Avatar	Standing with the feet wide apart and alternately transferring weight to the right and to the left. When leaning to one side, the hands and arms vertically hold an imaginary stick, producing considerable resistance when seemingly pressing it two times at each side. At the same time as pressing, the upper body bends sideways towards the ground. Simultaneously, the right knee bounces and the left knee twists towards the right.
Student 1	Standing with the feet somewhat apart, gently bouncing. Pushes the arms and hands sideways upwards, slightly pumping to the right and to the left.
Student 2	Standing upright with the feet slightly apart, bending and stretching the right arm.
Student 3	Standing upright. Horizontally holds an imaginary stick, pressing it lightly and sideways to the right and the left.
Student 4	Standing upright with the feet together. Alternately bending and stretching the left arm and the right.

Table 2: Description of tilted, bouncing and pressing

Findings – the students’ different ways of knowing two movements

The phenomenographic analysis resulted in three qualitatively different ways of knowing the movement ‘as something’. Additionally, in line with the notion of knowing how (Ryle, 1949) and tacit knowing (Polanyi, 1969), we regard the students’ knowing as expressed through their way of moving when replicating the avatar’s. The knowing of *hammering with bodily recoil* and *tilted, bouncing and pressing* is thus regarded as comprising mental and physical skills as an integrated whole. The three qualitatively different ways of knowing these particular ways of moving are represented by the three categories, therefore answering the question: how do the students considered to belong to this category seem to experience *hammering with bodily recoil* and *tilted, bouncing and pressing*?

In relation to each category of description, discernments of structural aspects are listed. These structural aspects provide a differentiated and detailed articulation of the meaning of knowing these movements. The structural aspects discerned laid the foundation for a further analysis based on the new phenomenography (the variation theory of learning).

The students’ different ways of knowing movement: Hammering with a bodily recoil

Three different ways of knowing the movement *hammering with bodily recoil* ‘as something’ emerged from the analysis, namely:

Category A: ‘Waving in the air, slightly bouncing’

The movement is performed foremost above the waist while one or two legs are slightly bouncing in relation to the arm movement. The lower part of the arm is waving back and forth like a windscreen wiper. In this category, the discerned aspects are:

- the raised position of the right arm;
- the hammering with the arm sideways;

- the weight transfer to the left;
- the arm–leg movement relationship.

Category B: ‘Waving in the air’

The movement is performed above the waist, foremost by the lower part of the right arm, waving back and forth. In this category, the discerned aspects are:

- the raised position of the right arm;
- the hammering movement with the arm.

Category C: ‘Waving with the hand’

The movement is performed foremost with the right hand. To a certain extent, the arm and sometimes the rest of the body are shaking as if the hand’s moving reverberates through the whole body. In this category, the discerned aspect is:

- The raised position of the right arm.

The students’ different ways of knowing movement: Tilted, bouncing and pressing

Three different ways of knowing the movement *tilted, bouncing and pressing* ‘as something’ emerged from the analysis, namely:

Category A: ‘bouncing, arms pumping’

The arms are raised, bending and stretching while pumping back and forth and bouncing slightly. In this category, the discerned aspects are:

- the bouncing;
- the bending and stretching of the raised arms;
- the alternately sideways moving.

Category B: ‘lightly pressing, arms pumping sideways’

The movement is performed foremost with the arms bending and stretching while lightly pressing an imaginary stick in front of the chest, alternately to the left and to the right. In this category, the discerned aspects are:

- The bending and stretching of the raised arms;
- The alternately sideways-moving arm.

Category C: ‘arms pumping’

The movement is performed foremost with the arms. One or both arms are raised more or less up in the air, bending and stretching simultaneously or alternately. In this category, the discerned aspects are:

- the bending and stretching of the raised arms.

In summary, the result of the phenomenographic analysis shows different ways of knowing the movements as well as what aspects are discerned and experienced simultaneously by the students. In other words, these aspects also describe knowing in terms of discerning, discriminating and differentiating aspects of a phenomenon.

If there is an assumption that these students are supposed to master the avatar’s movements in as complex a way as possible, we have to look at the avatar’s way of moving and analyze what aspects of the movements could be further discerned and experienced. Of possible significance regarding the first movement is that none of the categories show the discernment of the *bodily recoil*, that is when hammering with the elbow, the rest of the body goes in the other direction. The ways of knowing the second movement, as described by the categories the discernment of

the alternate transfer of weight to the left and to the right respectively as well as the relationship between the knees, need to be discerned simultaneously with all the other aspects presented in the analysis.

These aspects of movements to be known can be seen as examples to take into account when planning teaching and learning, which will be discussed below.

Discussion

A point of departure for this discussion is an assumption that the avatar's movements are the objects of learning: the students are supposed to learn these movements in as complex a way as possible. Another assumption is that learning movements can contribute to, and develop, the students' capability to move in terms of awareness, not separating mental and physical processes, as in line with Ryle's *knowing how* (1949, 2009), Polanyi's *knowing* (1962, 1966, 1969) and a phenomenographic approach to knowing and learning.

What the students know with help from the dance game

The result of the phenomenographic analyses shows what the students have learnt from playing the game so far. We can say in what way the students have come to know two dance movements. The ways of knowing can be articulated in terms of knowing the movements 'as something', and a particular way of knowing means also the simultaneous discernment of certain aspects of the movements.

In what way has the game then, functioned 'as a teacher' in terms of a movement educator, providing possibilities for the students to develop their knowing with a departure from what seems to be difficult for them to master?

What more is there to know and how can the students' knowing expand?

The findings show that the students have learnt from the dance exergame and know the movements in qualitatively different ways although they can develop their knowing. The findings also show *what* they can develop in order to know the movements in as complex a way as possible. *How* then can the game provide further teaching as well as opportunities for the students to know the movements in a more complex way, that is, as a change in one's capability to experience different phenomena in the world (Pang 2003, 153)? If taking into consideration that a necessary condition for learning is variation: 'to experience, understand, perceive or see something in a different way' (Runesson 2006, 397), the teaching should help the students expand their knowing by providing opportunities to discern and experience for the first time a variation of aspects of the movement.

Knowing the movement *hammering with a bodily recoil* as 'waving in the air, slightly bouncing', 'waving in the air' and 'waving with the hand' includes, for example, the discernment of the raised right arm. However, none of these categories show the discernment of the 'bodily recoil', that is when hammering with the elbow, the rest of the body goes the other way. This aspect could be regarded as critical to knowing the movement in a more complex way. Thus, planning for teaching and learning should include providing opportunities for students to experience a variation of this aspect. The bodily recoil in this movement could be described as moving the arm in one direction, whereas the rest of the body moves in the opposite. In what way could then this aspect be varied, based on the variation theory of learning? An example may be to let the students experience how it feels to raise the arms upwards while allowing the rest of the body to move in the opposite direction (e.g. bending the knees). What is varied in this example are thus the involved body parts. To vary the direction of the moving body in relation to a moving body part, the students need to experience how it

feels to move the rest of the body in the same direction, e.g. raising the arms from a position where the knees are bent and then stretching them simultaneously when raising the arms.

The above description of these detailed examples, necessary for the students to discern and experience, will, we argue, need a pedagogy which takes into account these issues. In sum, taking a phenomenographic approach to teaching means considering a specific group of students' prior knowing of the object of learning in order to understand how the teaching can help the students develop their knowing (Lo 2012, 105).

What the dance games need to do to improve 'as a teacher'

The planning of teaching should involve helping students' awareness of those critical aspects which emerged from analyzing the students' and the avatar's knowing of the movements.

Can the game provide these opportunities? A significant advantage of the game is that the students can go back and imitate the avatar's dancing as many times as they like. This can be described as a repeating method and will probably lead to changes in the students' capability to know the movements in a more complex way. This is, as we understand the game's role 'as a teacher', the main teaching method. However, the learning is left to the students: what aspects to be aware of will not be part of a structured pedagogical idea. A teacher though could plan and conduct teaching and learning which could enhance students' awareness of critical aspects of ways of moving in a manner that takes into account what the students already know.

Also part of the game's teaching method is the hand controller, which gives feedback to students in terms of scores, stars and ranking position. This kind of feedback may expand students' knowing although it depends, we argue, on what is valued through the feedback. It is important to note what the hand controller registers, which in this game is the player's hand movements. This circumstance can affect how the object of learning is apprehended by the students. Suppose a student ascribes the final scores more value than imitating the avatar as closely as possible,

then the awareness of the avatar's arm movement will probably come to the fore, thus encompassing what the students discern and experience. Suppose the game instead could register aspects of certain ways of moving, based on previous analyses of learners' common difficulties with the dance movements. A teacher could, however, in reality, observe students' ways of moving, give relevant feedback as well as plan for teaching changes in order to facilitate students' learning. Nevertheless, an underlying assumption involving this discussion is that PE teachers conceive themselves as educationists and not merely as organizers of activities.

In conclusion, using exergames as a pedagogical tool may enhance students' knowing in moving although there are some limitations to consider. Firstly, the game's function is focused on providing feedback through the hand controller in a way that may involve taking the direction of learning away from knowing the movements in as complex a way as possible. Secondly, the game cannot in its present form base the teaching on students' prior knowing of the movements to be known, which subsequently means that it is unable to systematically provide opportunities for students to discern and experience critical aspects of the movements. However, if a teacher uses the game as a pedagogical tool, and incorporates our suggested conditions for developing knowing in moving, then a fruitful pedagogical collaboration could be achieved.

Our contribution to the discussion of coordinative abilities, body consciousness and educating bodily senses as was described as lacking in PE (Larsson, Redelius, and Fagrell 2011; Redelius, Fagrell, and Larsson 2009; Evans 2004; Shusterman 2004; Kirk 2010; Tinning 2010) has included some aspects of what the capability to move can mean. Firstly, this phenomenon can be conceived of as subject-specific knowing, thus not 'merely' physical skills isolated from mental skills as our theoretical perspective on practical knowledge was described. Additionally, the phenomenographic approach contributed to an opportunity to analyze moving as expressing knowing and also providing a differentiated picture of what the capability to move in specific

ways can mean. By examining a certain exergame's role 'as a teacher', we have emphasized the capability to move, from the movers' perspective, as an intrinsic educational goal of PE while highlighting the need for systematically planning movement education.

References

- Biddiss, Elaine, and Jennifer Irwin. 2010. "Active Video Games to Promote Physical Activity in Children and Youth: A Systematic Review." *Archives of Pediatrics & Adolescent Medicine* 164 (7): 664–672.
- Dael, Nele, Mortillaro, Marcello and Scherer, Klaus R. 2012. "The Body Action and Posture Coding System (BAP): Development and Reliability." *Journal of Nonverbal Behaviour* 36:97–121.
- Dewey, John, and Arthur Bentley. 1949. *Knowing and the Known*, reprinted in John Dewey, *The Later Works, 1925–1953*, vol. 16, 1949–1952, edited by J. Boydston (Carbondale: Southern Illinois University Press, 1989), 1–280.
- Di Tore, Pio Alfredo, and Raiola Gaetano. 2012. "Exergame-Design and Motor Activities Teaching: An Overview of Scientific Paradigms on Motor Control." *Mediterranean Journal of Social Sciences* 3 (11): 119–122.
- Ennis, Catherine D. 2006. "Curriculum: Forming and Reshaping the Vision of Physical Education in a High Need, Low Demand World of Schools." *Quest* 58 (1): 41–59.
- Ennis, Catherine D. 2013. "Implications of Exergaming for the Physical Education Curriculum in the 21st Century." *Journal of Sport and Health Science* 2 (3): 152–157.
- Evans, John. 2004. "Making a Difference? Education and 'Ability' in Physical Education." *European Physical Education Review* 10 (1): 95–108.
- Harrigan, Jinnie A. 2005. "Proxemics, kinesics, and gaze." In J. A. Harrigan, R. Rosenthal, & K. Scherer (Eds.), *New Handbook of Methods in Nonverbal Behavior Research*. Oxford: University Press. 137-198.
- Hastie, Peter, and Peter Hay. 2012. "Qualitative Approaches." In *Research Methods in Physical Education and Youth Sport*, edited by K. Armour & D. Macdonald, 79–94. Abingdon: Routledge.
- Heath, Christian, Jon Hindmarsh, and Paul Luff. 2010. *Video in Qualitative Research: Analysing Social Interaction in Everyday Life*. Los Angeles: SAGE.

Hutchinson, Ann. 1954. *Labanotation: The system for recording movement*. London: Phoenix House Ltd.

Jordan, Birgitte, and Austin Henderson. 1995. "Interaction Analysis: Foundations and Practice." *The Journal of the Learning Sciences* 4 (1): 39–103.

Kirk, David. 2010. *Physical Education Futures*. Abingdon: Routledge.

Laban, Rudolf. 1956. *Principles of Dance and Movement Notation*. New York: Macdonald & Evans.

Larsson, Håkan, Karin Redelius, and Birgitta Fagrell. 2011. "Moving (in) the Heterosexual Matrix: On Heteronormativity in Secondary School Physical Education." *Physical Education and Sport Pedagogy* 16 (1): 67–81.

Light, Richard L. and Kentel, J. Adèle. 2015. Mushin: "Learning in technique-intensive sports as a process of uniting mind and body through complex learning theory." *Physical Education and Sport Pedagogy* 20 (4): 381–396

Lo, Mun Ling. 2012. *Variation Theory and the Improvement of Teaching and Learning*. University of Gothenburg. <http://gupea.ub.gu.se/handle/2077/29645>

Lupton, Deborah. 2014. "Data Assemblages, Sentient Schools and Digitised Health and Physical Education (Response to Gard)." *Sport, Education and Society* 20 (1): 122–132. doi:10.1080/13573322.2014.962496

Marton, Ference. 1981. "Phenomenography – Describing Conceptions of the World Around Us." *Instructional Science* 10: 177–200.

Marton, Ference. 1994. "Phenomenography." In *International Encyclopedia of Education*, edited by T. Husen and N. T. Postlethwaite, 4424–4429. 2nd ed., vol. 8. Oxford: Pergamon Press.

Marton, Ference, and Shirley Booth. 2000. *Om lärande* [About Learning]. Lund: Studentlitteratur.

Marton, Ference, and Amy B. M. Tsui. 2004. *Classroom Discourse and the Space of Learning*. Mahwah, NJ: Lawrence Erlbaum Associates.

Marton, Ference, and Pong Wing Yan. 2005. "On the Unit of Description in Phenomenography." *Higher Education Research & Development* 24 (5): 335–338.

Marton, Ference, and Ming Fai Pang. 2006. "On Some Necessary Conditions of Learning." *Journal of the Learning Sciences* 15 (2): 193–220.

- Meckbach, Jane, Béatrice Gibbs, Jonas Almqvist, and Mikael Quennerstedt. 2014. "Wii Teach Movement Qualities in Physical Education." *Sport Science Review* 23 (5–6): 241–266.
- Nyberg, Gunn, and Ingrid Carlgren. 2014. "Exploring Capability to Move – Somatic Grasping of House-Hopping." *Physical Education and Sport Pedagogy*. doi: 10.1080/17408989.2014.882893
- Pang, Ming Fai. 2003. "Two Faces of Variation: On Continuity in the Phenomenographic Movement." *Scandinavian Journal of Educational Research* 47 (2): 145–156.
- Papastergiou, Marina. 2009. "Exploring the Potential of Computer and Video Games for Health and Physical Education: A Literature Review." *Computers & Education* 53 (3): 603–622.
- Polanyi, Michael. 1962. *Personal Knowledge: Towards a Post-Critical Philosophy*. London: Routledge.
- Polanyi, Michael. 1966. *The Tacit Dimension*. Chicago: The University of Chicago Press.
- Polanyi, Michael. 1969. "The Logic of Tacit Inference." In *Knowing and Being: Essays by Michael Polanyi*, edited by Marjorie Green, 138–158. Chicago: The University of Chicago Press.
- Quennerstedt, Mikael, Jonas Almqvist, Jane Meckbach, and Marie Öhman. 2014. "Why Do Wii Teach Physical Education in School?" *Swedish Journal of Sport Research* 2 (1): 55–81.
- Redelius, Karin, Birgitta Fagrell, and Håkan Larsson. 2009. "Symbolic Capital in Physical Education and Health: To Do, to Be or to Know? That Is the Gendered Question." *Sport, Education and Society* 14 (2): 245–260.
- Runesson, Ulla. 2006. "What Is Possible to Learn? On Variation as a Necessary Condition for Learning." *Scandinavian Journal of Educational Research* 5 (4): 397–410.
- Ryle, Gilbert (1949) 2009. *The Concept of Mind*. Abingdon: Routledge.
- SFS 2003:460. The Act concerning the Ethical Review of Research Involving Humans. Stockholm: the Swedish Ministry of Education and Cultural Affairs
- Sheehan, Dwayne, and Larry Katz. 2010. "Using Interactive Fitness and Exergames to Develop Physical Literacy." *Physical & Health Education Journal* 76 (1): 12–19.
- Sheets-Johnston, Maxine. 2011. *The Primacy of Movement*. Philadelphia: John Benjamin North America
- Shusterman, Richard. 2004. "Somaesthetics and Education: Exploring the Terrain."

In *Knowing Bodies, Moving Minds: Towards Embodied Teaching and Learning*, edited by Liora Bresler, 51–60. Dordrecht: Kluwer Academic Publishers.

Staiano, Amanda E., and Sandra L. Calvert. 2011. “Exergames for Physical Education Courses: Physical, Social, and Cognitive Benefits.” *Child Development Perspectives* 5 (2): 93–98.

Tinning, Richard. 2010. *Pedagogy and Human Movement: Theory, Practice, Research*. Abingdon: Routledge.

Vander Schee, Carolyn J., and Deron Boyles. 2010. “‘Exergaming,’ Corporate Interests and the Crisis Discourse of Childhood Obesity.” *Sport, Education and Society* 15 (2): 169–185.

Vernadakis, Nikolas, Marina Papastergiou, Elina Zetou, and Panagiotis Antoniou. 2015. “The Impact of an Exergame-based Intervention on Children’s Fundamental Motor Skills.” *Computers & Education* 83: 90–102.

Öhman, Marie, Jonas Almqvist, Jane Meckbach, and Mikael Quennerstedt. 2014. “Competing for Ideal Bodies: A Study of Exergames Used as Teaching Aids in School.” *Critical Public Health* 24 (2): 115–132.