Weather Gods and Fruit Kids – Embodying abstract concepts using tactile feedback and Whole Body Interaction

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Abstract: In this paper we present findings based on the design and study of a game like activity that allows for physical and bodily interaction around abstract concepts like energy and energy consumption in a collaborative learning setting. The game, called Weather Gods and Fruit Kids, uses motion sensing technologies in combination with tactile and audio feedback to create an embodied interactive setting without computer screens. We analyze and discuss the properties of the interactive setting as well as the interactions with and around the system using characteristics such as multiple modalities of response, large space interaction and aspects of focus and attention. The work suggests that alternative pedagogical activities can be created providing new entries to theoretical concepts using an embodied interaction approach. In particular it may support kinesthetic learners in their preference to learn by being physically engaged.

Introduction

The use of physical and tangible objects has been a longstanding approach in design of technology for learning. A common argument both in learning technology design and human-computer interaction has been that physical interaction supports making abstract notions more concrete and easy to grasp (Ullmer & Ishii, 2000). A more recent trend is to design for interaction and experiences that involve bodily action and movement in a more significant way than by only introducing tangible interaction elements. This trend is sometime referred to as whole body interaction. Letting people engage in interactions using their whole bodies provides way to let people have new forms of experiences with technology that could not be achieved in a traditional hand-eye interaction styles.

In this paper we explore a game like activity called the Weather Gods and Fruit Kids designed for bodily interaction and kinesthetic learning in a school setting. The technology is designed to support children to interactively experience consumption, preservation and creation of energy, by sensing and responding to different aspects of the children's movements. Here we will present the design of the game, the design explorations leading up to it and some key outcomes from a study of children using the game.

Bodily interaction and the involvement of body and movement to interact with technology is an important part in the shift towards so-called post-WIMP interfaces. It concerns how by moving away from the traditional mouse and keyboard interaction we can allow for a richer, more multifaceted way of interacting with technology. By opening up the interaction space to include our full body we make use of a bigger range of our perceptual resources to make sense and understand the world (Klemmer et al., 2006). A range of recent work in HCI has addressed how bodily interactions and experiences should be understood and designed for, examples include focus on the felt aspects of experiences (Larssen et al., 2007) and approach of designing for the aesthetic dimension of physical experiences (Schiphorst, 2009). To understand such processes of experience some researchers have taken inspiration from physical activities with non-digital devices such as golf and skateboarding, or even horseback riding in order to outline key dimensions of physical experiences (see Tholander & Johansson, 2010; Höök, 2010).

The focus of the findings presented here is on the different ways children use their bodies in the interaction, the kind of experiences they have, and the role the technology plays in these processes. In the analysis presented we use the three themes from the analysis by Jonsson et al. on interactive spaces for physical interaction; (i) the role of the embodied performance for others; (ii) the role of the physical space in the interaction, and (iii) the role of device specific qualities in the unfolding of the interaction (Jonsson et al., 2009).

Background

There are the numerous explorations of technology that illustrate new ways of increasing bodily involvement in interaction, such as the Lega device for leaving physical traces of experiences at an art hall (Laaksolahti et al., 2010) , the eMoto system for bodily emotional expression (Sundström et al. 2007), BodyBeats for dance-based music creation (Zigelbaum et al., 2006), BodyBug the interactive movement partner (Moen, 2005) and the emotion and movement controlled game Emroll (Zangouei et al., 2010). Bodily ways of interacting have also grown commercially and become particularly popular in computer games. This includes an array of dancing and

sports games. For instance in Dance Dance Revolution where the player follow a sequence of instructions by dancing on a sensor mat, in WiiSports sports where the player performs movements mimicking those required in real games of bowling, boxing, tennis, or in music games like Guitar Hero and Rock Band where the player acts out pieces of music by playing on replicas of real instruments. These technical developments have drawn attention to the need to further understand people's interaction and experiences with bodily engaging technology, as well as to the interplay between physical, social and digital aspects of our experiences.

Issues of physicality, materiality, and social space are central in research on embodied interaction, pervasive computing and tangible interfaces, in which the particular physical manifestation of a computational artifact and its consequences for people's interaction and learning with and through the artifact is commonly brought to discussion (Hornecker & Buur 2006; Klemmer et al., 2006). These issues are also becoming increasingly relevant for design of collaborative technology for learning (Price, Sheridan et al., 2010) through the emphasis on how cognitive processes are deeply intertwined with and dependent upon our physical bodies and our relations to the material and physical properties of our social world. We experience and make sense of the world by moving in it, by exploring new situations through bodily interaction and with the material, physical and social surroundings (Lakoff & Johnson, 1999; Säljö, 2000). Thus, new interactive technologies that support mobile, bodily, and social activities beyond the desktop setting enable a shift both in the development of new forms of user interactions and experiences, as well as new tools to be used in learning activities. This aligns with much CSCL research as not being only the study of how people interact and learn with designed artifacts, but also the study and design of the situations in which efficient learning is taking place (Price & Rogers, 2004).

This paper presents findings from our close collaboration with an elementary school in Stockholm, where we made use of bodily interaction in a kinesthetic learning context. This ongoing collaboration started in large parts due to their pedagogical planning, their continuous use of technology in the classrooms and their extensive work with different learning styles (Dunn & Dunn, 1992). The work presented here falls within the area of so called kinesthetic learning, which is about how we understand and learn through bodily interactions and through moving in the world. The learning styles perspective starts out from the idea that different persons have different preferences with respect to how they engage in pedagogical activities. Out of the different learning styles adopted by the school, the teachers were most challenged to find ways of supporting the kinesthetic learners. A person characterized as primarily "kinesthetic" learn best by incorporating their entire body and movement in the learning process and these persons often have problems sitting still in one place and might prefer dramatizing and learning by doing or acting out. This acknowledgement of the importance of the tactile and kinesthetic dimensions fits well with recent research on tangible user interfaces and the emerging bodily interaction field as described above. In a previous study with the school we explored how learning situations can be created in mixed digital and physical settings, and how the properties of the respective media can be utilized to support exploration and learning (Ahmet et al., 2011). With the Weather Gods and Fruit Kids game, we continue this work by exploring how abstract notions of energy and energy consumption can be turned into something that can be experienced and interacted with in a physical manner using your body and movement.

The Weather Gods and Fruit Kids Game

The game Weather Gods and Fruit Kids is a result of a design process involving three previous workshops, one involving school teachers, and two where the children were introduced to the concept of energy in various ways.

The purpose of the first workshop was to find a concept for the children to explore through kinesthetic learning. Three teachers together with two members in the project group had a brainstorming session around some preliminary ideas. The teachers would reflect on suggestions for each of the ideas, and how they could be incorporated into their own respective teaching subjects where they themselves had difficulties incorporating kinesthetic dimensions. After numerous suggestions, the concept of consumption, charging and preservation of energy through using bodily movement was chosen.

The second workshop was designed as a bodystorming session with 20 children, to explore alternative pedagogical activities involving motion sensors and energy consumption. The children wore plastic stickers attached on arms and legs (see Figure 1), simulating sensors that would detect their energy consumption. The estimated energy consumption was then visualized on a computer screen and was reflected on during and/or after each exercise. The exercises involved throwing a large and small ball where the children would observe and compare the visualization of their respective energy consumption levels, moving to mimic a set of pictures (like a kite, snake or basket ball) and moving according to specific movement types, such as slow motion, robotic movement and big and round movements. The aim of the workshop was to simulate, rather ambiguously but in a simple manner, what it means to consume energy. Through different types of movements involving different body parts with varied intensity and strength, the children would at times comment on each other's movements and how it could be that certain movement types required more energy and why energy levels could at times differ from their own expectations.

In the third workshop the children were equipped with real sensors that would actually estimate their energy consumption. Ten children in groups of two were equipped with Nintendo Wii Remotes, nicknamed Wii Motes, on one arm and one leg. While performing a number of exercises they were encouraged to hypothesize and think about the outcomes from the exercises they were undertaking: i) running vs. walking where the children would firstly eat a slice of apple and then either run or walk while observing on a computer screen the type of activity that "consumed" the eaten apple the fastest, ii) the children would operate a lamp and a fan, while observing which appliance would run the longest on the approximate energy amount found in the slice of apple they had previously eaten, iii) moving to charge a 'smart battery' while listening to audio and vibration as feedback, the children would try to find the movement patterns that triggered a rhythmic sound from the Wii Motes. In this workshop, as well as the previous one, the use of sensors, simple visualizations and exercises were not meant to provide the perfect setting nor the correct procedures for analyzing e.g. energy consumption in real life but were designed to spur discussions with the children about the subject energy.

Figure 1. Workshop 2 (left) with fake sensor and wizard of oz prototype. Workshop 3 (right) attaching Wii Motes to arms and legs to detect movement and energy consumption

In the two workshops with the children, we found that although the children were exploring consumption and preservation of energy, they did it in a very controlled and structured manner. The activities did not contain much free exploration and experimentation around the concepts. The most striking result from these workshops was however how much the presence of a computer screen affected and restricted the movements in the room as well as the interaction between the children. Based on these findings we decided to continue with the relation between body and energy, but in a more self-contained activity were the technology would restrict the activity in the room as little as possible. From these requirements we ended up with an idea of a game activity without computer screens taking place in a large space like a gym hall.

The Game

The Weather Gods and Fruit Kids game engage four players to compete against each other in pairs by physically moving about in a large space, a gym hall, and simulating the generation, consumption and preservation of energy (see Figure 2). All players wear Wii Motes attached to one arm and one leg. The objective of the two fruit kids is to collect fruit cards that are spread out around an obstacle course, while not touching the ground. The motion sensors on the arms and legs of the players are used to estimate the amount of energy consumed when moving around the track. If not moving carefully, the players will run out of energy and thus lose the game. By collecting fruit and bringing it to their 'nest' they will refill their energy levels.

The opposite team, the weather gods, tries to obstruct the fruit kids by stealing their energy. By engaging in various magic dances, they charge energy that can when accumulated be released in the form of thunder and lightning (by pressing a button on the arm-mounted Wii Mote), which will reduce the energy level of the fruit kids. Moving around on a stage placed next to the obstacle course, the gods have a good view of where the fruit kids are and their actions. Rather than performing specific gestures or steps the weather gods interaction is designed for free flowing movement of a specific type: *Big & Fast*, *Slow-motion* and *Robotic*. In Big & Fast mode the movement is free but needs to be large and quick, in Slow-motion the movements need to be slow, smooth and continuous while in Robotic the motion should be very sharp, edgy and staccato. If the fruit kids manage to collect all the fruit without running out of energy they will replace the weather gods, and can be challenged by a new team of fruit kids.

The design was inspired by three of the interactional qualities introduced by Tholander & Johansson for whole body interaction: connecting to the physical space, harmonizing modalities and open-ended response (Tholander & Johansson, 2010). To allow for a head-up interaction (Soute et al., 2009), giving the player the possibility to freely explore movements in the physical space and be part of and aware of the larger activity in the hall, the interaction was designed specifically to not occupy the player's full attention, e. g. by visual feedback on a screen. Instead, to allow for a continuous attention to the activity and each other, harmonizing modalities was chosen in the form of vibration and audio feedback to support their understanding of their status

in the game. The Nintendo Wii technology was used for motion sensing as well as for tactile vibration feedback both for weather gods and the fruit kids. The current energy level of a fruit kid is represented as individual feedback through the use of vibration pulses with varying frequency; high energy - high frequency vibration and vice versa. For the weather gods the response was designed to be semi open-ended to allow for individual interpretation by the player, and no specific instructions were given on how to know when enough energy had been accumulated. The vibration would indicate whether the user's current body motion was the expected one, by vibrating at a regular time interval. Consequently, a lack of vibration could alert the user that the right dance style is not being danced.

Different forms of audio feedback was also used in the game, e.g. to inform when the fruit kids were out of energy, when lightning was thrown or when fruit cards were collected and new energy had been charged. All these sounds were provided through shared speakers that all players would hear. Individual sound feedback was also provided to the weather gods through the Wii Motes on the arms to indicate whether they were performing the indicated movement type. These sounds were very faint and were mostly only perceived by the bearer of the Wii Mote. The only visual feedback provided by the system was through a light flash that would light up the room whenever lightning was thrown by the weather gods. The researchers played no active role in the game other than indicating a change of dance style to the weather gods by holding up large signs from the tech booth situated inside a smaller room adjacent to the game area.
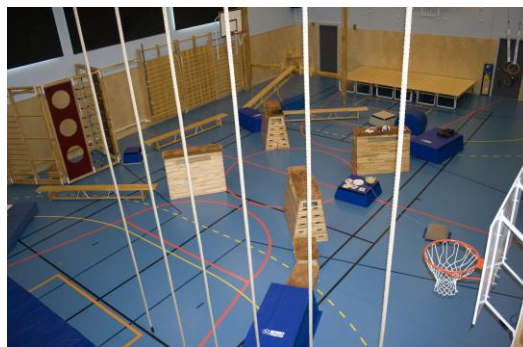

Figure 2. The game field with fruit kids' obstacle course and the weather gods' stage created in a gym hall.

Study and Method

Eleven children between the ages of 9 to 11 participated in the study. The study began with a sum up of the two previous workshops, an introduction to the game and a warm up session with playfully moving about according to the three weather god dances. Four children at a time would play the game while the others were observing on the side. A total of six game sessions were played followed by semi-structured interviews with questions formulated to gather qualitative data on how the activity was perceived, the purpose and also of the understanding of the underlying discussions around the concept of energy. The interviews and the game sessions were video recorded, with one camera filming an overview of the hall and the second filming the stage.

Findings

The particular focus of the findings presented here is on the different ways children use their bodies in the interaction, the kind of experiences they have, and the role the technology plays in these processes. The analysis is framed around the three themes presented by Jonsson et al. on design of spaces for embodied performance. The themes were adapted to the analysis of the interaction and learning in and around the Weather Gods and Fruit Kids game. The themes were interpreted and viewed upon in the following way; *Embodied performance* refers to how the activities take place in an open space without computer screens as dominating source of interaction with the participants. We also focused on the communicative function of different actions in the game, of how the actions performed by the actors in the game were not only directed towards the system and/or the game, but also played a performative role, directed more towards the other players and the spectators. *The role of the physical space* refers to how the configuration of the physical setting affects and restricts the interaction in numerous ways. The role of the physical space becomes especially interesting in this case since the interactive system is situated in a gym hall, which not only provided a large space for interaction and performance but also a space where the children are accustomed to moving and bodily ways of playing. *Device specific qualities* refer to how the properties of interaction devices and objects shape how the overall system and the game as a whole is perceived and interacted with. A particularly prominent aspect was how the setting and the devices encouraged the children to put significant efforts into interacting with the partner, the surrounding and the co-players rather than the technology. The findings are presented below, divided into each theme.

Embodied Performance and Experience

When performing the different weather god dances, the children were observed moving their bodies and different body parts equally much, with no specific emphasis on the arm or leg with the Wii Motes attached. Although instructed that the Wii Motes would sense and pick up their movement, they did not move that arm or leg more than the other; instead their whole bodies were involved and engaged. In a sense they were doing more than needed of movement, with the focus on the dance rather than the Wii Mote. In most cases with the weather gods the Wii Motes were just there, not dictating their movement or focus but was rather an extension of the body, creating an embodied experience and augmenting the child's ability to interact in the game. The children had done the same movement types in the previous third workshop, but had then moved in a more controlled and smaller manner. In the game however, when performing the very same movement types, they did so in a much more elaborate and free way. The game setting and its context, with the Wii Motes and the beforehand decided dances, seemed to give the children a frame within which it was allowed to play out and move in strange ways. While waiting for their game to start, one pair of weather gods would try out the different movement types and mimic shooting out a 'flash' by aiming with their arms out towards the fruit kids tracks. One pair pretended to be hit by each other's flashes by shaking their bodies and laughing. In this warm-up some couples would also rehearse movements to do later on in the game, like one pair doing a skier-movement. The freedom of how to move brought out the element of choreography in how many weather gods came up with their own movements.

While on stage, some weather gods were seen making weird, tricky and complicated movements involving the whole body from snaking with the head, twirling their fingers around and letting the experience be seen also in their facial expressions (see Figure 3). One pair doing the robotic dance made 'sch-sch' sounds to go with their movement, when trying to get into a rhythm. The freedom space in the game context seemed to allow for the children to tailor their own individual experience of really getting into the movement. This embodied experience was also shown in how many gestures and actions were exaggerated, for example the sending off of a 'flash'. The action was described as pushing a button on the Wii Mote, but on stage during the game the weather gods were seen to be in a more embodied state with not only pressing the button, but instead using their whole body to aim with the arm fully stretched out forward from the shoulder. Some were even squinting with their eyes as if looking through a riflescope to aim the flash (see Figure 3).

Figure 3. (Left and middle) Weather gods getting into the grove of moving, acting out with the whole body, and (right) aiming with the whole body to shoot a flash.

The Role of the Physical Space

In the whole body interaction in large space as a gym hall, the interaction space could be seen as divided into personal, near and far space. Firstly the weather gods would interact with their Wii Motes within their own personal space, their bodily sphere. One weather god moving in Robotic style was constantly changing the gaze of his eyes with sharp movement with the head to different directions showing how the interaction allowed for zooming out from what was happening in the surroundings and opened up for zooming in on the own personal experience and expression of the movement.

The second interaction space, the near space, included the fellow weather god on the stage. Despite the relative large open space, the weather gods tended to move around close to each other. When interacting in body-to-body style, i.e. doing fake hitting movements at each other in slow-motion, the closeness was natural but was also observed when moving freely but following each other around. When moving this close to each other they would also at times affect the movement space of the other person and hence also this persons movements (see Figure 4). E.g. one pair moving close by each other in slow motion was seen to adjust their bodies around each other with one moving her torso to make room for the other persons arm to slice through that personal space.

Lastly the stage was part of the larger gym hall space, and situated very close to the fruit kids. The children on stage would mostly have their focus on each other or on their own movement. Sometimes however,

events would make them become aware of the far-space. For example at one point the weather gods were looking only at each other but when hearing the loud 'eat'-sound, meaning a fruit kid had collected a fruit card and had raised his/her energy level, they looked up at the fruit kids. Then one of the weather god girls tapped the other one of the shoulder, said something in a low voice where after they both started moving more intensely to generate more energy. Many weather god pairs also talked about waiting for the fruit kids to get new energy from fruit cards before they sent off a flash, showing how the interaction allowed them to stay aware of the surrounding environment, what was happening out on the fruit kids track, despite their at times deep dive into the movement and their personal sphere.

Figure 4. Two weather gods influencing each other's movement space when doing a fake hitting action in the slow-motion dance.

Similar behavior was also seen with the fruit kids where in most situations they had their eyes on their own search for fruit cards. However, a sudden flash thrown by the weather gods made one fruit kid pair look up, where after they both started moving at a quicker pace (see Figure 5). They would jump down and almost run into their nest instead of calmly moving about as when they started the game. Despite the fact that they knew that moving in a faster manner will make them loose more energy, it was over ridden by the time pressure of getting their fruit cards to raise their energy level. In another session both fruit kids started to hurry up their pace after throwing glances at the stage where the weather gods were getting ready to fire off a flash.

Another example of becoming aware of far space happened when one weather god pair changed dance style into Big & Fast and started their beforehand rehearsed skier-movement, suddenly making a lot of thuds and noise on stage. One fruit kid on a path very close to the stage then started to move in a more hurried way. Prior to this, she had moved in a controlled and slow manner, to conserve her energy, but the loudness of movement from the stage made her look up and then move faster (see Figure 5). For the fruit kids, the importance of their role was to find a balance between movement and pace, in order to balance consumption and preservation of energy. While they were focused on finding and retrieving fruit cards to their nest, they would consider the implications of moving too fast (naturally leading to them consuming energy) and moving too slow (and becoming the targets of the weather gods' lightning).

Generally throughout the sessions both weather gods and fruit kids focus was observed to be mainly on the personal and near space but how the children spoke of their opponents in the game also shows how they did have a connection to the environment, that the interaction with the technology did not hijack their focus from being aware of their surroundings. Sound announcements from the speakers as well as noise from large movements on stage, did also alert the players to look up and observe the other team.

Figure 5. (Left and middle) Fruit kids keeping an eye on the weather gods before and while a flash, and (right) fruit kid becoming aware of the game situation by the loudness of movement from the weather gods.

Device Specific Qualities of Interaction

The vibration from the Wii Motes to the weather god's movement was an open-ended response, and no instructions were given as to when and how it would feel when enough energy was loaded to send off a flash. When asked how they knew that they had enough energy to send off a flash, one weather god said: "When it had a very high pulse", showing with one hand over the wrist where the Wii Mote was attached. Another God said that when "it was shaking much" they would alert each other through a code-word to coordinate to send off a flash. Sometimes the technology was not working properly, with the Wii Motes not being active, but those weather gods would find interesting ways to work around the tech gap, with one child saying "I didn't feel

anything from mine, but I heard that Otto's was going on like this" as to how he would hear the vibrations of his partner's Wii Mote as a cue for sending off a flash. Even though this was a discrete sound it apparently caught the attention despite the surrounding noise. This personal feedback became a joint feedback in between the weather gods and helped them coordinate their actions.

For fruit kids it was rather the absence of vibration that caught their attention. When asked what was a bit challenging in gameplay, they said "One felt when there was little left, and if one wasn't back in the nest then I thought 'I have to hurry' and started moving faster but then I thought 'no, I have to take it slow otherwise…'", showing how also the absence or the very weak vibration feedback made them notice and become aware of their status in the game. The low volume sound emitted from the The Wii Motes of the weather gods was an open-ended response. One child said "And then there were these tiny clicking sounds, when one was doing the right movement" about how he interpreted it as doing the right movement type. This was a rather faint sound (as the Wii Mote speakers did not allow a strong sound) and thus became more of a personal feedback.

When basing our interaction on the familiar Wii technology we were half expecting to see some children just shaking the Wii Motes to generate energy instead of moving according to dance styles. Contrary to this though, the children were in most cases moving as if the Wii Motes were not there, e. g. when acting as a robot and mimicking it with their whole bodies. Those times when it did come into focus were situations when the technology did not work or the Wii Motes fell out of the attachments to the body. Also the participants seemed to be aware of the Wii Motes more in the very beginning of their game. One fruit kid began to hold the arm where the Wii Mote was attached rather stiff through the track, but as the game progressed the movements became more smooth and he would move freely also with the Wii Mote arm. Even the weather gods would check that they were securely fastened but when the game progressed they would move more as one entity with the Wii Mote, rather than focus on it. From the weather gods there was a natural focus on our tech booth as they would receive cues for changing dance style by us holding up a sign. Yet they would aim to shoot a flash at the fruit kids and not towards our tech booth where the loudspeaker and the flashing lamp was situated.

In the interviews, the experience of the vibration feedback on the skin did mostly arise as a topic when describing different peak situations, such as almost being out of energy or being ready to fire off a flash. Fruit kid players did not speak specifically of the healthy high pulse that meant they were doing fine and had energy to take them through the tracks, but talked about being aware of it when the pulse grew weak and the energy started to run out. The loud audio feedback from the speakers would make the children look up and make them aware of changes in the game. When waiting in line to play, the children would observe the games and as the session progressed they learned tactics of how to move to win. But when asked what they understood when they were observing, one boy said "one didn't know how it felt" and his friend "and how fast one could move before it ran out", in support of how the vibration feedback actually did help them understand their status in the game.

Discussion and Conclusions

The gym hall setting for the activity and our choice of using several different modalities had the effect that there were no obvious points of focus for shared information about the status of the game. Even though based on and dependent on technology, the activity became to a certain extent de-coupled from the computer system. Instead of focusing on the technology, the different groups had their focus on their immediate activity and movement and would from time to time update themselves by looking around or be made aware of the overall status in the game by audio cues and events happening out in the hall. The system provided feedback and information in multiple modalities: personal feedback in terms of on the skin vibration, joint sound feedback in the near space, and public feedback through audio and light. The effect of designing open-ended vibration and sound feedback yielded personal interpretation and enabled an individual experience. The vibration feedback proved to be a strong indicator and was most noticeable when situations reached some kind of emergency limit, e.g. when energy ran low and the pulse grew weak, suggesting that the healthy pulse remains in the periphery until its absence is discovered. It is felt via the body, just as we are unaware of the states of our body until a change occurs that make us consciously focus on the body part that signals the change. This suggests how feedback felt by the body could be powerful to use for interaction in environments where the user's attention is highly distributed. Specifically, it highlights how the absence of a feedback to the body can be used as a strong response to catch a user's attention.

The game allowed for an element of performance in how the children would do more than needed by the technology sensing their movement. In contrast to an earlier study of bodily interaction with a digital artefact where the players spoke of trying to please the technology they were interacting with (Tholander & Johansson, 2010), the children playing this game did not move just because the Wii Mote needed it but because their experiences was built from movement and embodied interaction. It would have worked equally well to interact with the system by only moving the Wii Mote arm and leg, but instead all children, moved their whole bodies in rich ways. How the weather gods children would move in free, creative and engaged ways adding facial gestures and sound effects, showed how the context of the game allowed for personal exploration a space of freedom to tailor the activity to their own preference. These weird, exaggerated movements performed for the

pleasure of moving, shows how the activity opened up for an embodied experience with open-endedness in interaction and response. It is also noticeable that for bodily movement interaction, the 'safe zone' or frame for moving created by the game, opened up the creativity space for the children to dare to explore using movement.

The large space gym hall setting for the activity gave different dimensions for experience, from embodied interaction in the personal space to being part of the larger whole in the hall. To successfully interchange between near and far space, the interaction should make use of both system response (like audio) but also alerts from the real world setting (of thuds, noises, or other naturally occurring sound from other movers in the surrounding). We argue that by adapting the interchange needed between the different spaces, it is possible to build activities and learning environments that allow for both a rich experience of small details in the personal space to a joint understanding of concepts in the larger whole, through both system and real world feedback and interaction.

The aim of the project was to explore the possibilities to spur discussions in a subject through designing for learning by using bodily movement in a large space setting. Based on the outcomes of our design process and the game, we argue that this shows a promising approach for designing for alternative pedagogical practices that supports in particular kinesthetic learners in their need to learn by being physically engaged.

References

Ahmet, Z., Jonsson, M., Sumon, S. I. and Holmquist, L. E. (2011) Supporting embodied exploration of physical concepts in mixed digital and physical interactive settings. TEI '11. ACM

Dunn, R. and Dunn, K. Teaching elementary students through their individual learning styles. Allyn & Bacon Inc, Boston, 1992.

Hornecker, E. and J. Buur (2006). Getting a Grip on Tangible Interaction: A Framework on Physical Space and Social Interaction. CHI 2006, Montreal, Canada, ACM Press.

Höök, K. (2010). Transferring Qualities from Horseback Riding to Design. In Proceedings of NordiCHI, Reykjavik, Iceland, October 18 - 20, ACM Press

Jonsson, M., Tholander, J., Fernaeus, Y. (2009). Setting the stage – Embodied and spatial dimensions in emerging programming practices. Interacting with Computers 21(1-2): 117-124.

Klemmer, S. R., Hartmann, B., Takayama, L. (2006). How bodies matter: five themes for interaction design. DIS '06, ACM Press.

Laaksolahti, J., Tholander, J., Lundén, M., Solsona, J., Karlsson, A. (2011), The Lega: A Device for Leaving and Finding Tactile Traces, Proceedings of TEI' 11

Lakoff, G., Johnson, M. (1999). Philosophy in the Flesh: The Embodied Mind and Its Challenge to Western Thought. New York, Basic Books.

Larssen, A.T., Robertson, T., & Edwards, J. The feel dimension of technology interaction: exploring tangibles through movement and touch. TEI'07, (2007), 271-278.

Moen, J. (2005). Towards People Based Movement Interaction and KinAesthetic Interaction Experiences. In proc. of CC '05 decennial conference on Critical computing, August 21-25, Aarhus, Denmark.

Price, S., Sheridan J. G.et al. (2010). Action and representation in tangible systems: implications for design of learning interactions. Proceedings of the fourth international conference on Tangible, embedded, and embodied interaction. Cambridge, Massachusetts, USA, ACM: 145-152.

Schiphorst, T. soft(n): toward a somaesthetics of touch. Ext. Abs. CHI'09, (2009), 2427-2438.

Soute, I., Markopoulos, P., Magielse, R. (2009). Head Up Games: combining the best of both worlds by merging traditional and digital play. Personal Ubiquit. Computing, SpringerLink

Sundström, P., Ståhl, A. and Höök, K. (2007). In situ informants exploring an emotional mobile messaging system in their everyday practice. Int. J. Hum.-Comput.Stud., 65 (4). 388-403.

Säljö, R. (2000). Lärande i praktiken - ett sociokulturellt perspektiv. Bokförlaget Prisma.

Tholander, J., Johnssson, C. (2010). Bodies, boards, clubs and bugs: A study of bodily engaging artifacts. CHI10' Extended Abstract on Human factors, April 10-15, Atlanta, GA, USA

Tholander, J., Johansson, C. (2010). Design qualities for Whole Body Interaction – Learning from Golf, Skateboarding and BodyBugging. NordiCHI'10, ACM Press

Ullmer, B. & Ishii, H.(2000). Emerging frameworks for tangible user interfaces. IBM Systems Journal, 39(3-4), 915-931.

Zangouei, F., Babazadeh Gashti, M. A., Höök, K., Tijs, T., de Vries, G-J., Westerink, J. (2010). How to Stay in the Emotional Rollercoaster: Lessons Learnt from Designing EmRoll. NordiCHI '10. ACM Press

Ziegelbaum, J., Millner, A., Desai, B., Ishii, H. (2006). BodyBeats: Whole-Body, Musical Interfaces for Children. CHI 06' April 22-27, Montréal, Québec, Canada, ACM press

Acknowledgments