Understanding the design space of an instructed physical activity in a co-located, social setting

Inspiring the digital by looking at the physical

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Human-Computer Interaction
30 hp

VT 2015
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Sammanfattning

Under de senaste åren har vi kunnat se en ökning av HCI design inom området interaktiva spel och sport som förlitar sig på rörelsebaserad interaktion. Denna designstruktur kan i vissa fall påverka användarna negativt genom att avgränsa dem från den sociala och fysiska omgivningen runt omkring dem. Vi tror att när man skapar en ny design, är det viktigt att ha en god förståelse av aktiviteten för att minska sådana begränsningar. I denna studie, har vi valt att titta närmare på träningsformen Pilates för att studera de element som är involverade i en lyckad, social och välinstruerad fysisk aktivitet där alla deltagarna är på plats samtidigt. Här observerar vi till exempel vilka roller samt kategoristiska drag dessa element har. Detta gör vi genom att samla information från en inspelad Pilates lektion, samt undersöker instruktörens och utövarnas uppfattning genom en enkät. Genom en analys av videon, inspirerad av grounded theory metodik och sekventiell analys; samt en analys av enkäten genom en förenklad version av innehållsanalys, har vi kunnat se vilka element som är involverade i en sådan aktivitet (instruktör, utövare och andra artefakter) samt de interaktioner som existerar mellan dem. Utöver detta har vi också fastställt vilka rollerna för dessa element är (vad utövar dessa element) samt de kategoristiska dragen av dessa roller (på vilka sätt de utövas). Utgående från dessa resultat presenteras implikationer för design som undviker onödiga begränsningar för användarna.

Abstract

During the past years, gaming and sports in HCI have experienced an increase in design that rely on movement-based interactions. Nonetheless, some of these designs constrain the users and disregard the richness of the social and physical context around them. When designing an activity, we believe that a good previous understanding of it can help designers to create richer and less limiting interventions. On our study, we turn to Pilates in order to study the elements involved in the accomplishment of a working, co-located, social and instructed physical activity, as well as which are their roles and their characteristics. In order to do so, we record a Pilates class and gather information on the perceptions of the instructor and the practitioners, through questionnaires. An analysis of the video, inspired by the Grounded Theory methodology and Sequential analysis; and also an analysis of the questionnaires, through a simplified version of Content analysis, reveal which elements are involved in such an activity (instructor, practitioners and artifacts) and the interaction that exists among them, as well as which are their roles (what do these elements perform) and the characteristics of those roles (in which way they are performed). Here we illustrate the different results with examples from the data and, in basis to this data, we review some relevant findings and provide some inspirations for future design interventions.
ACKNOWLEDGEMENTS

This thesis would not have been possible without the help of different people, to whom I am very grateful, both for their aid and support.

I would like to thank first my supervisor, Elena Márquez Segura, who dedicated effort and time to not only supervise me but teach me and guide me in these early steps of becoming a researcher. Her ideas and advices have helped me define this thesis, and I consider both as an indispensable part of it. I am thankful for everything I have learnt and all the opportunities she has provided me with.

Secondly, I would like to thank Kristina Widerborn, professor of Pilates, without whom I could have never carried the study with the facilities she provided. She was interested from the beginning in the project, and helped perform a class, supervise the questionnaires and overall, provide a great environment to work with.

In the same line, I would like to thank Sabri, Lucía, Inés and Robert, for participating in the video-recording part of the study. Along with them I want to thank Carmen and George, for their interest all throughout this thesis.

Moreover, I want to thank all the people in Duet Rambla Fondo gym, in Spain, who participated by answering the questionnaires.

And last but definitely not least, I thank my parents, Bibi and Ferran, for their constant support, despite the long distance; and I specially thank Dimitris, for his encouragement in the good days and patience in the not-so-good ones, and his prompt help whenever I needed it, that made me overcome the difficulties I encountered along the way.
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1. INTRODUCTION

Despite the growing interest and impact over the past few years that movement-based interactive systems have had in the HCI community, in fields such as gaming or sports, the deficiencies in some of these systems have not gone unnoticed by researchers and users (Bogost, 2007 as cited by Mueller, Agamanolis, Vetere, & Gibbs, 2009; Mueller et al., 2009; Schwanda, Ibara, Reynolds & Cosley, 2011) and even people in the industry (Hurley, 2012).

From a technical point of view, it has been argued that the limited sensing capabilities of some systems constrain the moving body (Márquez Segura, 2013). Examples can be found in successful commercial applications, like Kinect, which is known to struggle with its technical limitations (Molyneux, in Pakinkis, 2011), or like Nintendo Wii, where the movements performed by the players are translated into a limited set of options, and afterwards converted into actions in the screen (Ludvigsen, Fogtmann & Grønbæk, 2010), limiting the range of movements that can be sensed, and therefore, limiting the people using them.

Furthermore, still regarding such commercial applications, many rely on the traditional videogame scenario, where there can be found a stationary device sensing the movements and a screen displaying the game, a scenario that has already started to be questioned due to the limited experience they offer (Hurley, 2012). This kind of set-up is detrimental to plenty of activities which do not rely on this type of physical layout, and by physical layout we mean both the spatial context but also the physical material (i.e. artefacts) that can be found in an activity. For instance, Nintendo Wii's sport games, like boxing or tennis, that can be played by two people competing with each other, force the players to locate themselves side by side, facing the screen. By being located in such a way, the players are not able to see (except, maybe, peripherally) what the other player is performing, and thus, they may miss important cues on the other player's intentions, anticipations or strategy.

Another drawback that these kind of systems face is the lack of engagement from the users' side. Schwanda et al. (2011) found in her study about Nintendo Wii Fit that people who had been using the system in the past had either stopped using it, or decreased dramatically the amount of time they spent with it. Some people found Nintendo Wii Fit boring or repetitive, not being an effective motivator for everybody. Other approaches, like Playstation Gamercize for a foot-stepper, or Xbox PCGamerbike, are based on physical activities, such as treadmill exercising, that present high drop-out rates (Bogost, 2007, as cited by Mueller et al., 2009) and that users deem purposeless and meaningless (Weinberg & Gould 2006). As Mueller et al. point out, “most emerging interactive systems that consider exertion
aim to address individual aspects associated with non-participation in physical activity. They either try to increase engagement, but fall short in supporting the creation of a meaningful exertion activity, or they facilitate a more meaningful activity, but can only generate limited exertion levels well below those associated with traditional sports”.

But not only the technical limitations, or the lack of engagement, constitute the set of deficiencies: the social aspect has also been found as one of the main drawbacks of some of those applications. Studies indicate that physical activity has a positive impact on social bonding (Mueller & Agamanolis., 2005; Weinberg & Gould, 2006) and encourages social interaction and friendship (World Health Organization, 2003). People do not only seek the physical exercise when performing an activity, they enjoy the social contact too (Zahariadis & Biddle, as cited by Mueller, Agamanolis & Picard, 2003). As Putnam (2000) indicates, places that people attend to practice an activity, do not only function as places to exercise: they also become social spaces. Bogost suggests that, in comparison with traditional sports, systems as the Nintendo Wii and EyeToy do not afford the social rituals that take place in an exertion activity. Systems seem to concentrate on the exertion aspect, but fail at providing mechanisms that support the social aspect (Mueller et al., 2009).

Last, but not least, this lack of social context can lead to a lack of engagement. The social aspect (being part of a group, forming connections and companionship and fostering social support) has been suggested as one of the motivators for participating in physical activities (Laverie, 1998).

As we have reviewed, some movement-based interactive systems present certain deficiencies, which relate to technical limitations (such as the sensing capabilities), to the traditional videogame scenario, the users' lack of engagement and the disregard for the social aspect.

**1.1. Our stand**

We believe that the limitations of some movement-based interactive systems can be overcome by acknowledging in their design not only the technological aspect, but the social and physical context as well. Bearing this in mind, we regard the work of Márquez Segura, Waern, Moen and Johansson (2013) as the starting point and inspiration of this study. Márquez Segura et al., in their paper “The design space of body games: technological, physical, and social design”, account similar limitations, specifically addressing the gaming field. They also provide examples of different approaches that include in their design elements regarding the social, the physical and the technological factors.
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However, they take a step forward and promote the inclusion of such three factors as design resources, which is reflected in the two games that they present (Make My Sound and B.U.T.T.O.N.). Nonetheless, in Márquez Segura et al.'s work they use such three factors as design resources for new systems or technological interventions, in their case, games. In our study, instead of studying a technological intervention, we advocate for looking into an already functional and rich activity. Works such as the one of Tholander and Johansson (2010), whom return to the “real world” to study the movements and interactions with non-digital artefacts in practices like golf and skateboarding, serve as an inspiration for our study.

1.2. Goal

In this thesis, we want to understand what is happening in a certain physical activity, throughout the study of the same, in order to provide a comprehensive understanding of the way the different elements involved in such a type of activity work towards its accomplishment. In particular, we are interested in studying the elements involved in an instructed physical activity that occurs in a co-located, instructed, social setting, that may or may not incorporate artefacts in its practice.

Following Márquez Segura et al.'s work, we expect that a close look into a rich activity that involves different elements and occurs in such a setting, can influence and inspire technological interventions in similar settings.

In order to study an activity that is characterized by these factors, we have turned into Pilates since it includes all of them, as it will be further covered in the chapter Background.

In basis to such factors, which draw the scope of this thesis, the research question's scope is presented: understand the elements involved in a working, co-located, social and instructed physical activity.

With its subsequent questions:

1. Which are the elements involved?
2. What are the roles of such elements?
3. How are these roles characterized?

We regard the activity as 'working', given its success over time, its popularity and its multiple benefits (as we will further cover in the next chapter, Background). We understand the activity as 'co-located',
for it occurs in a certain context and environment, with all the parties present; and we regard it as 'social', for the interactions (and the possibility of interactions) that arise between the people in the activity. Finally, we deem the activity as 'instructed', for it counts with a person who educates and guides the practitioners, the instructor.

1.3. Methodology

As researchers, there is a need for taking a standpoint on questions of ontology, epistemology and axiology (Creswell, 2007), since they will determine the methodology and methods of the study.

In this study, we advocate for an ontological viewpoint that argues that multiple realities exist (Charmaz, 2003). We are dealing with interpretations of the world, shaped not only by persons and context, but the researchers themselves, and thus it is not possible for us to adopt a standpoint of a pre-existing objective reality in the social world. This leads to the second question, concerning epistemology and what type of knowledge can be generated through research. Accepting that the aim of research is not to describe objective reality, but to examine and seek different interpretations of it, and understand how it is framed in the social, temporal and cultural context, we take a constructivist standpoint. As Charmaz poses, the knowledge generated in this study provides an interpretation of the studied scenario. We are creating, and not discovering, knowledge about how the world is constructed, and the role of the researcher can not and should not be disregarded, since they influence both the process and the product of research (Charmaz, 2003). The outcome of the study is an interpretative theoretical model that is valid for the studied scenario under the conditions that were given.

Concerning axiology, or how the values of the researchers influence the research, we argue that our values shape our choice of approach and questions asked, as well as how the study has been conducted. A reflection of it can be found in the chapter 'The study'.

1.3.1. Grounded Theory Methodology

Developed by Barney Glaser and Anselm Strauss in their work The Discovery of Grounded Theory (1967), grounded theory method allows the researchers to move back and forth from data to theory, allowing new contextualized theories to emerge, grounded in the data (Willig, 2008). Throughout the years, both the original authors and other researchers have developed new versions of grounded theory, and in this study we advocate for the approach of Charmaz, who provides a constructivist point of view, where both the researcher and that what they research is what produces the data.
Willig writes about the basic principles of grounded theory: “grounded theory involves the progressive identification and integration of categories of meaning from data. It is both the process of category identification and integration (as method) and its product (as theory). Grounded theory as method provides us with guidelines on how to identify categories, how to make links between categories and how to establish relationships between them. Grounded theory as theory is the end-product of this process; it provides us with an explanatory framework with which to understand the phenomenon under investigation.”

In order to identify such categories the researchers undergo the process of coding, from its early stages, with descriptive instances (open coding), to more abstract units of meaning, the concepts, that integrate other categories (axial coding) (Willig, 2008). The coding process is subjected to constant comparative analysis (moving back and forth from the data, identifying similarities and differences) and memoing (writing of memos, pieces of text, to document the process, which gives validity to the process (Willig, 2008).

Concerning when to finish the process of data analysis, the original work of Glaser and Strauss strives for theoretical saturation, meaning that the researchers continue to code the data until they can not be identified new categories or variations of the existing categories (Willig, 2008). In this study we prefer to use 'theoretical sufficiency', like Dell suggests (as cited in Charmaz, 2006) which means that the different categories have been sufficiently developed, and thus the relationships between them can be explored, and conclusions can be drawn.

1.3.2. Content Analysis Methodology

Content analysis comprises different methods used to examine pieces of text, in search for the existence of certain words on phrases (Neuendorf, 2002). There are two general approaches to content analysis: conceptual analysis and relational analysis. In the first, the analysis is performed with the aim of identifying recurring concepts through words or sentences; whereas in the second, the goal is to explore the relationships among such concepts (Writing@CSU, n.d.). We use in our study an approach inspired by the conceptual analysis approach.

1.4. Contribution
The study offers an overall look of an activity that is co-located, social and instructed. We think that
the study can contribute to inspire future design interventions. We will pose suggestions for inspiration
(chapter Discussion), but a review of the findings can unravel other opportunities for design.
Moreover, the findings of the study can be used as a tool for analyzing existing systems, and the
methodological approach used can serve as an inspiration for future similar studies.

We identify the elements involved in the activity we have studied, their roles and their characteristics,
as well as the relations existent among them. Besides, we present several themes (findings) that are of
relevance in the accomplishment of the activity. Finally, we propose some possible implications for
future design interventions.
2. **BACKGROUND**

In this chapter we are going to present relevant theory in our study. First, we are going to review different approaches in HCI to movement-based interactive systems. Secondly, we will review Pilates as an activity that works. Finally, we are going to present relevant theory related to activities in general, and specifically, instructed activities.

### 2.1. Movement-based interaction: perspectives

Movement-based interactive systems is a field in HCI where the moving body is the source of input of the system (Loke & Robertson, 2013). It is characterized by its focus on the body, and the main role of the latter in the design process (Loke & Robertson, 2013). In order to design with and for the body, HCI researchers have turned into theories about embodiment as theoretical tools in which to support their research (Robertson, 1997). Phenomenological approaches of embodiment pose that through interacting with our world, we give meaning to it, and that such interaction is an embodied experience, since our tool to do so (interacting with the world) is our bodies, which mediate and anchor such interactions (Merleau-Ponty 1962; Robertson, 1997; Svanaes 2000; Dourish 2001). Therefore, accepting a phenomenological approach to HCI, it becomes obvious the importance for interaction designers to take into account the lived body, and the possibilities of interaction with the world that it offers.

Research into embodied approaches to movement-based interactive systems, therefore, focus on studying the movement, the body and the experiences, rather than taking technology as the starting point (Loke & Robertson, 2013). In order to do so, as Schiphorst observes, there are different subjective perspectives that are shaped by how a person observes themselves and the world. In designing body experiences and movement-based systems, several researchers have decided to adopt first-person methodologies in their practices (Loke & Robertson, 2013), which allow them to get an inner insight, through the design cycle (Márquez Segura, 2013) of the activity and the body performing it.

A first-person perspective intentionally turns the focus inwards, to the same observer and their body, and the relationship of such a body with the world surrounding it.
Several researchers and designers in HCI use first person methodologies (Schiphorst & Andersen 2004; Hummels, Overbeeke & Klooster. 2007; Larssen, Robertson & Edwards. 2007a, 2007b; Loke & Robertson 2010; Schiphorst, 2011). Moreover, they also have inspired design methodologies, like Loke and Robertson's perspectives of the mover, the observer and the machine (Loke & Robertson, 2013).

In our research though, we believe that these first-person approaches, although providing insight on the personal experience of somebody regarding their body and the world around it, fall short in providing the social dimension (the relations between the different bodies and elements) the importance they have in movement-based systems, and specially in those that are social, co-located and instructed.

Interestingly, other perspectives exist on how to design for the moving body and how to use technology with the goal of creating more engaging experiences, like Mueller et al.'s (2010) exertion framework, in which they provide a simple structure to describe how the body responds, moves, senses and relates to other bodies and the context in which the physical experience occurs.

As they state in their work, Mueller et al. build upon Jacob et al.'s framework (Jacob, Girourad, Hirshfield, Horn, Shaer, Solovey & Zigelbaum, 2007) (which suggests a four lens view), and the phenomenological approach to the 'lived' experience of van Manen (2014) (which takes into account corporeality, temporality, spatiality and relationality), to present their four lenses (perspectives) structure: the responding body; the moving body; the sensing body; and the relating body.

**Lens 1: the responding body**
Mueller et al. argue that any physical experience from an outer layer will have physiological responses from the body when performing an activity. This first perspective focuses on such responses, both on the immediate ones (i.e. increased heart rate) as well as on the further ones (i.e. weight loss). The role of this perspective in interactive systems can be understood as means of biodata.

**Lens 2: the moving body**
Deals with the muscular response and the repositioning of the different body parts during the physical experience. Unlike in the responding body, the moving body implies movement, thus being linked to spatiality and temporality.
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**Lens 3: the sensing body**

Relates to the world and how the body senses and experiences it, emphasizing the interaction between the two. The artefacts involved in the activity (if any), and the physical environment are taken into account in this perspective, therefore aiming at providing a contextual perspective.

**Lense 4: the relating body**

The last perspective encompasses the social dimension, how bodies relate to one another in a wide range of roles (i.e. co-participants, instructor, audiences).

Mueller et al.’s devised the exertion framework as a set of tools for analyzing and designing exertion games. An example of how it can inspire the design can be found in their own work: ‘Hanging off a bar’ relies on the idea of dispensing with one of the perspectives as means of introducing a challenge. Others, like (Márquez Segura, 2013) have gone as far as including the different perspectives as design resources for physical and social activities.

Nonetheless, for the present thesis, this exertion framework is used as a tool to assist research, providing a theoretical approach to how to look into the activity, and inquire about it. Although there is not an agreed upon framework for designing/analyzing activities with the features that the present thesis contemplates (social, co-located, movement-based, instructed) (Márquez Segura, 2013), we believe that Mueller et al.’s approach may help discern the different features and elements involved. We have chosen to conduct our research with the last three perspectives in mind: the moving body, which regards to the movements of the participants in such activity, what triggers them and their quality; the sensing body, regarding how the participants relate to the objects and the space around them; and finally the relating body, dealing with the social dimension of the activity and the relations that occur between the bodies.

Nonetheless, there are two main differences between Mueller et al.’s original framework and the work here presented: first, in this thesis the relating body perspective does not regard ‘digital technology’ as the channel in which relations between bodies occur (given that we study an activity without a digital component). Secondly, the original framework counts with a first perspective, the responding body, which has not been used as a mean of approaching the studying of the activity, for it holds less relevance to the research question. It is out of the scope of this thesis to focus on the physiological reactions of the practitioners.
2.2. Examples in HCI

As previously stated, we believe that some approaches at designing movement-based interactive systems have been constraining and limiting for their users (Bogost, 2007, as cited by Mueller et al., 2009; Mueller et al., 2009; Schwanda et al., 2011), sometimes due to technical drawbacks, but also due to not taking into account the physical, as well as social, context of an activity, which results in systems and applications that disregard the richness present in physical activities. On the other hand, there exist systems that take into account the richness of a physical activity, or aspects of it. We are going to review some of these approaches to illustrate the existing variety of movement-based interactive systems in the HCI field, as well as their strengths and weaknesses, and at the same time highlight the gap we are trying to fill with our approach of studying a physical activity before designing for it.

On one hand, we have examples of a type of systems where the technology, inspired by an existing physical activity, helps pull the activity out of its context in order to recreate it in a different setting. Examples of that are the already mentioned Nintendo Wii Boxing game is a good example of an exertion application that fails at grasping the context of the activity it aims to emulate. The context provided by the game holds little resemblance to an actual boxing match. It has already stated above that the kind of approach to videogames that platforms as Nintendo Wii have does not provide a real physical context, that users can relate to the real activity. Another problem posed by this kind of approach is the limitation given by the technology: in Nintendo Wii Boxing, the player "fights" the screen, and is encouraged to punch and hit the air in order to score, which results in no kinesthetic feedback (Mueller et al., 2009).

Social Yoga Mats (Maybach et al., 2011) is another example of a design that tries to recreate the activity at home. In their approach, similar to our work, they attended yoga classes for senior people in order to collect ethnographic data, study the social dynamics and observe the role of the instructor, and afterwards to follow up with an early-stage design of social yoga mats that, along with a screen, are connected to each other through the internet. With a functional prototype, the users would be able to take a social yoga mat home, and see when the other users 'connect' (when they access the mat to perform some exercise), and that they are exercising. In their scenario, the users know each other forehand form a real yoga class, and they argue that seeing the others exercising at home can become a motivation in order to do it as well. Nonetheless, we see two shortcomings in this approach: first, although the activity has been studied in-situ, meaning that ethnographic data regarding yoga has been gathered, there is no account of such data or results of the study of the data in their work. Secondly,
their design does not contemplate any means of interaction between its users, and they state in their scenario that they expect the interaction to happen via traditional channels, such as the next physical yoga class and through telephone. Summarizing, what they create with the social yoga mats is an artefact that the practitioners can carry home, and that informs them of when any of them is exercising home, through the lighting up of an avatar in the screen. Thus, an approach that looked into the real activity falls short in using the knowledge gained to recreate the physical and social context.

On the other hand, there are some examples of design solutions and research that strive for more contextualized systems, putting the technology into the activity, and not otherwise.

Mueller et al.'s work (2003, 2010) argue that the social aspect of a physical activity is central to the activity, and their designs aim at support social bonding. However, their interest lays on distributed settings (Mueller et al., 2003), and how to connect people who are in different places performing the same activity at the same time. An example of their work is 'Jogging over a distance' (Mueller, Vetere, Gibbs, Edge, Agamanolis & Sheridan, 2010), where two persons, not co-located, agree on running at the same time. Through a headset, a heart rate monitor, a mini computer and a mobile phone, both participants are connected, and able to speak to each other. The computer compares the changes of heart rate in both participants, and displays the voice in the headphones according to the effort assessed: side-by-side, in front or behind. As they argue, it is interesting because the distributed setting and the solution allow people with different capabilities to exercise together. On the other hand, the non verbal cues that may emerge in a co-located setting are lost in this type of solution, and the difficulty increases when designing for more complex activities in distributed settings.

Other interesting examples are those where the technology tries to fill a gap of the real physical activity, and is designed to fit into the activity in a non intrusive way.

Zatoń and Szczepan (2013) tackle the problem of providing real-time feedback to competitive swimmers. Through their device, a wearable headset with headphones, swimmers can get real-time feedback on their performances, straight from the instructor, and adjust to it. It is very interesting how this solution brings the instructor to the medium where the swimmers are, and transforms an activity that is co-located in an activity that is col-located in real-time. With their proposal, the instructed aspect of the activity is enhanced, with proven success.

Another example of these types of designs is the Killer App (Chi, Song & Corbin, 2004), where the participants of taekwondo are equipped with wearable devices that assess the hits, and thus help the judges in grading the performance more accurately. In this case, the technology is again designed to be
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non intrusive, with the aim of providing the judges with real feedback on the hits, without having to rely on the visual assessment of the movement. Nonetheless, Chi et al. report having faced problems with the technological approach, given the violent nature of the taekwondo, and suggest that new ways of implementing it should be studied.

Finally, there is a very interesting example of a system that takes into account the physical and social aspects, as well as the activity for which is designed. TacTowers (Ludvigsen et al.) is a system devised to support professional handball players to train tactical skills in close-contact situations.

The prototype consist of four towers, each one of them with eight 'balls', rounded elements that align vertically along the tower, slightly bigger than a handball ball, which are at the same time interaction devices and displays. The balls are provided with touch sensors and lights, at certain heights and places, emulating the crucial points that a handball player has to have into account, regarding common points of interaction in the real activity (taking the towers as an allegory of a real player). The initial condition of such 'balls' is being turned off. Ludvigsen et al. include the instructor in this next step, as designer of the activity and game. Depending on the nature of the game that the instructor decides to create, the different lights turn on and off. The lights can represent multiple things, again according to what is desired: they can represent the ball, and the trajectory it follows; they can represent several crucial points in which a real offender would move the real ball, and thus the aim is to touch them and turn them off, as many as possible, etc. Another interesting aspect is that the towers can be placed wherever in the field, and the different players can move around the towers freely, in order to follow up with the exercises.

We find this solution interesting: it advocates for an inclusion of the technology in the real setting where the activity occurs, without disregarding the physical or social context. Moreover, the instructor is not disregarded, as in other approaches (Social Yoga Mats, before reviewed), but rather the system aims at including it in the practice. The TacTowers can be placed in the very specific setting where the real activity takes place, thus supporting the co-located context. It allows the interactions between players to emerge in a natural context, it includes the role of the instructor (as person programming the different exercises with the TacTowers) and is susceptible to changes in the game design, both structure-wise and content-wise.

As stated above, there are various examples of different implementations of the technology in movement-based systems. Some of them try to recreate a physical activity, disregarding the physical and social context in which it takes place, like the commercial systems. Others advocate for bringing the technology into the context that the activity takes place. Mueller's research has a strong focus on
the social aspect, but they base their research in distributed settings. Examples of how the technology can be used to fill a gap in the activity itself have also been posed, but they lack previous insight into the activity. For instance, the problems faced by Chi et al. in their Killer App prototype could have been foreseen with a better insight on the activity and the violent nature of the same.

In any case, all of them, although being interesting examples, they do not look at the activity as a whole, neither conduct a broad research on the activity itself, but try to solve a specific problem through their designs.

The last example, the TacTowers, shows how the technology can be included in an a physical activity without disregarding the physical and social context, nor limiting the players; but although the interactive activity seems to consider the rich socio-spatial context around, similar to the physical activity in which its design is inspired, it is not clear how this activity informs and influences the design of the interactive system.

We advocate for the importance of studying the activity that is being designed for (or from which it is desired to gain knowledge so as to inform other types of similar activities), in order to understand the way that the different elements involved, alongside with their roles and characteristics, accomplish the successful making of the activity. And through such understanding, being able to inspire future design interventions in similar activities, without disregarding the richness present in the activity itself.

As previously stated in the Introduction chapter, we have turned into Pilates as object activity of our study, since it is a co-located, social and instructed, working activity. We continue with a description of what Pilates is and why we regard it as an activity that 'works'.

2.3. Pilates

Wells, Kolt and Bialocerkowski, in their review of more than one hundred of peer-reviewed works describing Pilates (Wells et al., 2012), state that the most common acception of what is Pilates, according to the majority of her sources, is: “a mind—body exercise that focuses on strength, core stability, flexibility, muscle control, posture and breathing. Exercises can be mat-based or involve use of specialized equipment”.

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It was firstly developed by Joseph Pilates during the first decades of 1900, who was initially inspired by anatomy studies, bodybuilding, gymnastics, boxing, yoga and martial arts, to later include physiotherapy techniques and creation of his own apparatuses to perform different exercises (Di Lorenzo, 2011). Throughout the years, Pilates has become increasingly asserted as an exercise of global popularity (Di Lorenzo, 2011), and new forms of Pilates (modified pilates, pilates-based activities and pilates-inspired) have emerged (Wells et al., 2012).

Among the scientific community there are two different trends of thought: some of them consider Pilates as a suitable exercise for rehabilitation purposes (Rydeard, Leger & Smith, 2006) whereas some of them argue that Pilates cannot be considered a physical therapy by itself, in its ‘pure’ form (i.e. Wells et al., 2012; Caldwell, Adams, Quin, Harrison & Greeson, 2013). It is not within the scope of this thesis to advocate for one position or another, but to state diverse benefits, either physical or socio-psychological, that can been found in the literature, regardless of considering Pilates as a suitable physical therapy or not.

For physical benefits, Pilates is argued to lead to uniform muscle development and better coordination (Di Lorenzo, 2011) as well as improved core stability and posture (Cruz-Ferreira, Fernandes, Laranjo, Bernardo & Silva, 2011, as cited by Boix Vilella, León Zarceño & Serrano Rosa., 2014; Di Lorenzo, 2011); to help develop flexibility (Rydeard et al., 2006; Cruz-Ferreira et al., 2011, 2011, as cited in Boix Vilella et al., 2014 ; Caldwell et al., 2013) and strength (Caldwell et al., 2013; Cruz-Ferreira et al., 2011, as cited in Boix Vilella et al., 2014). In those studies where a derivative of Pilates was used as a physical therapy, for instance, to treat chronic low back pain, it was found that not only the derivative was more efficient than other techniques, but it lead to a decrement of pain and to improved general health, along with improved proprioception (Di Lorenzo, 2011).

As for psychological benefits, Pilates is argued to improve self-efficacy and mood (Caldwell et al., 2009; Cruz-Ferreira et al., 2011, as cited in Boix Vilella et al., 2014; Caldwell, 2013); to lead to relaxation, enhanced self-awareness, and decreased stress (Di Lorenzo, 2011; Caldwell et al., 2013); to help emotional and physical well-being (Keng, Smoski & Robins, 2011); and improve self-image (Cruz-Ferreira et al., 2011, as cited in Boix Vilella et al., 2014).
We regard Pilates as an activity that 'works', given that: it is a popular, well established, successful and socially accepted activity, practiced over time by a large number of people, along an increasing popularity (Di Lorenzo, 2011) and it presents several health benefits, as above stated.

2.4. Relevant Literature

Beyond reviewing the activity as a whole, there are some components present in Pilates (and in multiple other activities) that we consider relevant to mention.

The first of these components is the feedback. We define the feedback that relates to the implementation of an exercise, movement or position as the “information conveyed (...) about the extent to which the behaviours and performance correspond to expectations” (Cusella, 1987; as cited by Carpentier & Mageau, 2013). Such information can be change-oriented (traditionally known as negative feedback), or promotion-oriented (traditionally known as positive feedback) (Carpentier & Mageau, 2013).

Promotion-oriented feedback aims at encouraging the performance executed (Carpentier & Mageau, 2013). On the other hand, change-oriented feedback aims at changing some aspects of the performance, and although it is found to support two important aspects on the practitioners' side, motivation and performance improvement, it is equally important to know in which way and when to provide it, since it can lead to anxiety, decreased self-esteem and poor relationship with the instructor (Carpentier & Mageau, 2013). Research (Mouratidis, Lens, Vansteenkiste., 2010; Carpentier & Mageau, 2013) points out that change-oriented feedback results in positive reactions (more self-esteem, motivation and greater well-being) when it is provided in a way that supports the athletes' autonomy. Carpentier & Mageau pose in their work the definition of autonomy, as described in the self-determination theory (Deci & Ryan, 1985): “(self-determination theory) posits that humans' psychological health and optimal functioning are facilitated by interpersonal contexts that support the basic psychological need for autonomy, i.e., the universal desire to feel that one is at the origin of one’s actions and that one’s actions are concordant with one’s values”. In basis to this definition, Carpentier and Mageau illustrate the different ways in which change-oriented feedback can be defined as autonomy-supportive: if it provides foundation to why the behaviour should be changed; if it considers the practitioner's perspective (takes into account their feelings and difficulties); if it provides different choices of solution; and if it is provided in a non-controlling communicating style (which would include shaming, conditional regard and threats of punishment).
The importance on how to deliver feedback leads to the next relevant component, the instructor. Several studies highlight that the behaviour of the instructor can result in either positive or negative consequences on the practitioners performance and phenomenological experience (Carpentier & Mageau, 2014). The already mentioned autonomy-supportive approach by the instructor has also been posed as being beneficial for the practitioners, opposed to the controlling instructing style (Mouratidis et al., 2010; Carpentier & Mageau, 2013). In an autonomy-supportive instructing style, the instructors consider the feelings and the needs of the practitioners individually; in a controlling style, the instructors push the practitioners to feel and think in a specific way (Deci & Ryan, 1985; Carpentier & Mageau, 2013).

Insofar, we have introduced two instructing styles, according to Carpentier and Mageau and similar approaches' research. Nonetheless, to illustrate the last component, instructing style, we are going to present some of them that are included in the Spectrum of Teaching Styles (STS), a framework that poses different teaching-learning styles regarding the decisions that the instructor and the practitioners make (Mosston and Ashworth, 2002). Although the complete STS has eleven different listed styles, we are going to illustrate three of them (Style A – command, Style B – practice, Style E – Inclusion), as Byra, Sanchez and Wallhead (2013) do in their study of these teaching styles in a fitness activity like Pilates, given their relevance to the practice. The full STS aims at depict different styles for teaching physical education in general, but emphasizing the type of physical education taught in schools, and thus, a variety of the styles included do not take place in an activity like Pilates.

Ashworth (2008) defines the three mentioned styles as following: “In the commanding style (A), the teacher selects the task that the students perform in a unison, choreographed or precision performance image following the exact pacing and rhythm (cues) set by the teacher. In the practice style (B) the teacher selects the subject matter tasks, the quantity, and the time limits so that students can practice individually and privately. The teacher circulates among all students and offers private feedback. In the inclusion style (E) The teacher selects the subject matter skill and designs multiple levels of difficulty for each skill. Students select the level of difficulty that is appropriate to their performance. If inappropriate level decisions are made, the student may change the level choice.”

The commanding style can be referred as 'follow the leader'. All the decisions are made by the instructor, who also provides general feedback while commanding, whereas the practitioners follow him or her. In the practice style, the instructor shows the practitioners what is to be performed, and while they are performing it, he or she checks them and provides feedback. Finally, in the inclusion style, the practitioners are offered different options and/or levels of difficulty from which to choose (Byra et al., 2013).
We have started this chapter by reviewing several different design approaches to movement-based interaction systems in the fields of gaming and sports, and we posed their weaknesses and strengths. We have also defined the activity Pilates and its benefits. Finally we have introduced theory regarding feedback in sports, the role of the instructor and the spectrum of instructing styles.

3. THE STUDY

In this chapter we present the method we followed in our study, divided in two blocks. We first present the two approaches that we followed in order to gather data: the video recording of a Pilates class and the distribution of questionnaires, both to instructors and practitioners. In the second block, we describe the methods used for the data analysis.

Throughout this and following chapters we employ two terms for addressing the people who attend Pilates: participants and practitioners. Participants strictly stands for the people who attended the recorded class and participated in the study, whereas the word practitioners refers to the general population that practices Pilates, and also to those who answered the practitioners' questionnaire.

3.1. Design of the study

In order to gather the data that we would use in our study, we opted for video recording a class of Pilates and distributing questionnaires. With the recorded class we aimed at being able to gather data of the activity as a whole: what is happening, when and how. But a recorded video provides insight only about the aspects that can be observed from outside, it does not provide insight on people's ideas or conceptions. Due to this fact, we decided to create the questionnaires, in order to aim at gathering data that is not observable in the video that could be useful.

3.1.1. Recorded class
In order to find a class of Pilates that could be recorded, we contacted several fitness centres. Campus 1477 (www.campus1477.se), a fitness centre in Uppsala, offered the most amenities for our type of study: English speaker instructors, with several classes of Pilates during the week. We contacted the responsible of Pilates and Yoga of the centre, K., who besides being responsible happened to be conducting a course on Pilates, and she quickly became interested in the study.
3.1.1.1. Setting
We attended during one month, as participants, the classes of Pilates that K. was instructing, in order to get a first insight into the type of activity, and following, agreeing with the instructor how and when the class that we would record would take place. The instructor had a requirement in order to let us record a class: it had to be a class that she would conduct specifically for the study, on the date accorded, since the ongoing classes that she instructs are conducted in Swedish, and she would not feel comfortable speaking in English, neither would she focus so much on the students participating in the recording. Nonetheless, the instructor had experience in teaching reduced groups as well. Therefore, we still managed to record the activity in a real setting.

3.1.1.2. Participants
The purpose of attending the classes was to recruit participants for the study. Although people attending such Pilates classes were differently approached (presenting the study and encouraging participation, both at the end and at the beginning of the class; personally approaching recurrent people, that had seen us and known about the research from previous classes; with the help of the instructor, who introduced the topic and encouraged participation), it resulted to be an unsuccessful recruitment. Some of them showed interest, and answered the questionnaires (see next section), but did not want to participate in the recorded class. Therefore, we asked people we knew that would be interested into participating in the study (four participants, students, between twenty-two and twenty-five years old, whom perform physical activity regularly, although neither of them had performed Pilates before).

3.1.1.3. Procedure
The instructor performed a class for the four participants, that consisted of two parts: basic principles of Pilates, where she provided information about what Pilates was and the main body areas of focus, and Pilates matwork, where a series of exercises, with and without artefacts, were performed. Two cameras were used to film the activity, facing the instructor and one facing the participants.

The instructor designed a class for Pilates' beginners, which lasted fifty minutes and was performed in the same fashion that had been observed by the researchers in the general classes: with the same routines and the same exercises. The way of instructing the class, providing feedback and relate to the participants did not change either.
It is very interesting to point out here how the characteristics of the class (reduced group) shaped the physical distribution. At the beginning of the class, before setting up the cameras, we had a brief discussion with the instructor about where to locate the cameras and the participants. Although we suggested the traditional setting that we had observed in the other classes we attended (the instructor in a scaffold, with the mirror wall behind her and the students facing her in a half-circumference), the instructor moved the class to a place closer to the mirror wall, where she was located at the same level as participants, and everybody was closer to the wall, to the instructor and to each other, which, according to K., is the setting she uses for reduced classes.

After finishing the class, the questionnaires were given to the participants.

### 3.1.2. Questionnaires

As previously stated, we created two questionnaires, one for the practitioners and one for the instructors.

#### 3.1.2.1. Practitioners' questionnaire

The questionnaire of the participants was focused on two main areas: the different channels through which they obtain information about their performance and their corrections, and the role of the objects in their performance, given that those areas could not be so easily observed in the video.

The questionnaire was subject to multiple iterations, and received the approval of the Pilates instructor, K., who stated that it tackled real issues in the practice of the activity.

The questionnaire was handed to the participants of the recorded class, after the end of the activity. We also sent a link to the questionnaire online to some of the practitioners of the regular classes of Pilates we had been attending, although few responses were received.

We decided to translate the online questionnaire to Spanish, and send it to practitioners of Pilates in a local gym in Spain (Duet Sports Center Fondo, https://ramblafondo.duetsports.com/), where we had
contact with the instructor, in order to gather more answered questionnaires. The total number of questionnaires gathered was twenty five questionnaires.

3.1.2.2. Instructor's questionnaire

We also created a questionnaire for the instructors, which was focusing on almost the same aspects as the one for the participants: different channels and techniques they used to get and convey information from and to the participants and issues regarding the shaping of the class (i.e. level of skills, number of practitioners).

This questionnaire was subject to multiple iterations as well, and the same Pilates instructor, K., supervised it. The questionnaire was sent to different Pilates instructors that we knew, but by the time of writing this study, only K. had answered.

3.2. Data analysis

The recorded video was analyzed using a method inspired in Grounded Theory Methodology. The two videos from the two different cameras were composed into a single track. The video was visualized several times in order to identify and code events (open coding) that were deemed relevant in answering the research questions.

The different instances coded were then grouped and rearranged several times, resulting in more abstract units of meaning (categories), which at the same time were also categorized in more abstract units (axial coding).

Along this process a comparative analysis of the instances within the categories was performed, as well as a comparative analysis of the instances among themselves, and relating to the data back and forth. Moreover, memos were written to keep track of the different iterations of the process.
The analyzing process was stopped once we considered that theoretical sufficiency was achieved, due to time constrains.

Besides analyzing the instances, sequential analysis was taken as inspiration to analyze the sequences in which such instances occur, in order to underpin them to the context.

Regarding the questionnaires, they were analyzed using a very simplified version of Content Analysis. The questionnaires were scrutinized looking for relevant concepts, which were organized into themes (see chapter Introduction for an overview on the methodology).
4. RESULTS

In this chapter the results of our study will be presented. As detailed in the chapter 'The Study', we analyzed the video recording of a class of Pilates and two types of questionnaires: a questionnaire for the practitioners and a questionnaire for the instructors.

During the analysis of the video, we realized that the categories that were being produced were related either to the instructor or the practitioners, and the same occurred with the questionnaires, which were targeted to either one or another. Taking into account such characteristic, we have decided to present the results in two blocks: 'instructor's perspective' and 'practitioners' perspective'. This differentiation does not imply that the results are linked only to the instructor or the practitioners, as it will be later observed in the text, but that the point of view of one or the other has been adopted to present them.

In the results we have opted for expanding and enriching the categories with transcriptions of the video material, screenshots illustrating relevant sequences of actions and quotes from the videos. We have also included content and quotes from the questionnaires. As stated in the chapter The Study, we have analyzed the content of the questionnaires with an approach inspired by Content Analysis, through which we have obtained different themes. In the section instructor's perspective we have opted for presenting the results of the questionnaire of the instructor together with the categories, given that they are related, and aim at enriching the latter. In the section practitioners' perspective, we have opted for including the results of the practitioner's questionnaire after the review of the categories, since the themes found are not as well related to the categories as in the instructor's case.

4.1. Instructor's perspective

In this section, we present the different instructor's perspectives. At the beginning we provide the resulting conceptual map of the analysis of the video. The map shows the categories that are linked to the instructor, and how they are connected to each other. Following we describe and illustrate the categories, using them to present important sequences of the video, for which we have taken inspiration from sequential analysis. Such sequences usually revolve around an instance of the category, but longer sequences have been posed in the examples, to provide the reader with context.
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4.1.1. Conceptual Map

The map presents the different categories, and the relations among them (bi directional relations), to which arbitrary colors have been attributed.

4.1.2. Explanation of categories

For the sake of clarity, we will explore the categories top-down, from the more abstract categories (dark blue in the map) to the less abstract categories (yellow in the map). The main categories, in dark blue in the map, will be presented: cueing, feedback, request, answer, checking and use of artefacts. The less abstract categories (in green in the map) which link to them will be explored, and examples of how are they characterized (in yellow and light blue in the map) will be provided. The header of each category is designed to correlate to the map, and thus, try to clarify the relationships between categories. Moreover, some subcategories can be classified regarding if they are of a verbal or non-verbal nature, which is also stated in the headers.
4.1.2.1. **Cueing**

In our work, we define cueing as any indication, signal, reminder or hint, either verbal or non verbal, aimed at a person to make them perform in a specific way. The results indicate that the instructor uses cueing in three different scenarios: in the explanation of the exercise, in providing corrections and when providing alternatives to some of the exercises. Each one of them is going to be further explained, and illustrated with examples below. *Correction* though, due to its complexity and being part of cueing and feedback at the same time, will be treated individually afterward.

**Cueing > Explanation**

We define *explanation* as the actions, either spoken or not, through which the instructor illustrates an exercise, movement or position, and/or explains how to perform it. It also includes those actions that, if do not explain the exercise themselves, help to explain them. We make a distinction between the explanation without any corrective purpose, and that used when correcting a movement/position, which is going to be treated under *correction*.

Following, we are going to pose the different ways of explaining that have been found in the video analysis. Examples of it can be found in the next sections. The results show that there are several ways in which the instructor provides an explanation, which is supported by K.'s answer of the questionnaire of the instructors, regarding what ways of explaining are used: “*showing exercises with my own body (…), which is the base of teaching groups, verbal instructions and hands on. People with better self body awareness tend to assimilate verbal easier*”.

**Cueing > Explanation > Verbal > Shifting attention**

We name *shifting attention* the practice where the instructor makes the participants focus on certain areas of their body. This has been observed to happen in the middle of explaining the exercise, when the instructor is explaining the exercise and the participants are performing it simultaneously. An example is depicted in the images below.
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Images 1, 2 and 3 correspondingly: The instructor is explaining an exercise that consists in lying on the floor, with one leg resting on the mat and another up in the air, while having the elastic band passing around the raised foot and holding it with both hands, as it can be observed in the first image. With this position, the participants are supposed to make circles in the air with the raised leg without bending the knee. The instructor is explaining the exercise by *describing* and *modeling* it (both are ways of explaining an exercise, and will be treated under their correspondent section). When the students are already performing the exercise fluently, the instructor stops her explanation and stands up (image 2), approaches the participants and makes them *shift the attention* to their hips (image 3): “and now, let's focus on what's happening down in your hips, are they steady? Or not?” (K.). Some participants answer positively to her question, and she provides an explanation on what to do next, in case that the hips are not steady: “if not, more tension in your deep abdominals” (K).

**Cueing > Explanation > Verbal > Labelling**

The instructor includes in her explanation the names of some of the exercises. We have called this *labelling*, providing a name to an exercise. This happens with simple exercises or positions. One example is found in an exercise where the participants are sitting on the mattress, with the elastic band tensed under their open arms, and they have to rotate the torso right and left (for screenshots of this exercise, check feedback / cueing > correction > verbal > reminders > image 50, 51). The instructor provides the name of this rotation of the torso while she is modeling it: “exhale, stay here, interspine twist” (K.). Another example of labelling is found in the exercise depicted in the images found in the last example of cueing > explanation > verbal > description > images 14, 15, 16, where the participants are instructed to perform 'the bridge', a position that requires them to lay down on the mattress, with bended knees, and raise their gluts, without raising the upper back, head and arms.

**Cueing > Explanation > Verbal > Imagery**
In this study we use the term *imagery* as defined by The Oxford Dictionary of Sports Science & Medicine:

“A psychological technique involving the production of vivid mental experiences by the normal processes of thought. In sport, imagery is an extremely versatile technique (...) that can involve any sensory experience. In practising a skill, for example, imagery is especially effective if the athlete imagines the auditory, olfactory, tactile, and kinaesthetic sensations associated with performing the skill well”. There are found three approaches of this way of explaining an exercise or position. In the first approach, the instructor refers to positions that are culturally associated to feelings.

In image 4, the instructor has started to explain a new exercise that will be performed with the bands, and requires a certain initial position, which she is adopting in the image 4: flexed legs, straight back and relaxed shoulders. The instructor resorts to a use of imagery previously mentioned: “we want to sit in a position in which you think that you can finally stand a... straight position in the back. A 'proud' position” (K.). In this example, she associates a proud position to have a straight back, in order to illustrate the position.

Another approach to *imagery* is when the instructor tells the participants what they should be feeling, as a cue on what is the 'correct' way to feel. Unlike in the previous example, the instructor uses this approach in the middle of the exercise, while she is instructing them what to do and the participants are performing accordingly. Image 5 helps to illustrate this example.

As it can be observed, the instructor is explaining the exercise and the participants are performing it. The instructor and participants in the image, appropriately, show the sequence of the exercise, which is to be performed laying on the mat on one side, with both arms touching (as the instructor shows, standing up on the right of the image), and slowly open the top arm (as the participant closer to the instructor is performing) all the way to the other side (as being performed by the participant on the left
of the image), and then go back to the initial position. While the participants keep performing the exercise, the instructor uses this form of imagery: “on your way back you feel your belly, sculpting your abs” (K.). After that, she keeps performing the exercise.

Finally, the last approach to imagery that the instructor uses is making the participants imagine a situation that relates to the position she wants them to adopt. This type of imagery is found in a situation when the instructor tells the participants to adopt a neutral position on their back (image 8), which is supposed to be held in other moments of the activity. In order to make them adopt such position, the instructor chooses to make them adopt first a forced position on the lower back (image 6), and slowly change to another forced position (image 7), where the hips are pushed forwards. The purpose of the exercise is to keep performing the transition from one forced position to the other, to finally achieve the neutral position. However, when the instructor explains for first time the transition from the first forced position to the second, she uses the already mentioned form of imagery: “imagine that you have a tail that you are pulling forward, between your legs” (K.), which exemplifies how to transition from one position to the other.

Cueing > Explanation > Verbal > Description

Description is one of the most used ways of explaining an exercise. The instructor provides a description of the exercise, movement or position, meaning that the actions that are to be performed are verbally described. This kind of explanation is found both at the beginning of explaining an exercise and throughout it. The images below depict an exercise that is being explained from the beginning, and in which the instructor uses description.
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The exercise consists of the steps that the images above depict, upon which the instructor also describes: “place the band underneath your feet (image 9), feet together, and now, find your seat bones (image 10), and then come here, curving your back, relaxing the shoulders, and let's find the balance (image 11, where they raise their feet to the air and stay suspended there) scrub your belly around your back, as much as possible, inhale, roll back (image 12), exhale, and come back to this position (image 13)” (K.).

Description is also used during the exercise, both to keep explaining and to introduce changes to current exercise, as it is the case of the example depicted in the images below.

In this example, the participants have been performing an exercise that is called 'bridge', and which consists in initially laying down on the mat, as the participants perform in the first picture (image 14) and afterwards raise the back and gluts, to achieve the position performed by the participants in the
second picture (image 15). After finishing some repetitions of this basic ‘bridge’, the instructor proceeds to introduce a new feature in the exercise, which consists in raising one leg up into the air (image 16) once the basic bridge position is achieved, and bring it back down to the basic bridge. She describes it, and at the same time the students perform what she explains: “now, this time, we are going to do it a bit stronger, so we are going to get up to the bridge (said and performed during image 14), stay up there next time you are up to the bridge, stay up to the bridge (said and performed during image 15), just keep on breathing, and next time you exhale, please, lift up one foot, without dropping your butt (said and performed during image 16)” (K.).

**Cueing > Explanation > Verbal > Reminders**

The instructor includes reminders of positions she has explained before by only mentioning the name of the position, instead of explaining the position all over again. This kind of cueing can be found in one example, at the beginning of the explanation of an exercise, where the instructor asks the participants to keep a neutral position which she has previously described (the sequence where she describes the neutral position can be found in cueing > explanation > verbal > imagery) while working on another area of the body. She instructs an exercise to relax the shoulders (‘shoulder release’). The exercise consists of bringing the shoulders up (as can be observed in image 17) and then, abruptly, letting them down again, in order to release the tension (image 18). Before explaining this exercise, she includes the name ‘neutral position’ in her utterance, so as to remember the participants of it: “now, let’s move to shoulders. Commonly, the back has a lot of tension, the shoulders as well. We try not to be like this from the stress around you. So we are going to do the same. Neutral position, control your breath as well, inhale, shoulders up to your ears, feel the tension, and exhale, release the tension down, all the way” (K.). All of them implement the position.

**Cueing > Explanation > Verbal > Sound**

We define sound as those vocal expressions that do not have meaning but are uttered to support, in our study, a movement. Due to its nature, it is difficult to provide an acoustic example in this thesis, but two of the most comprehensive examples are the sound that the instructor makes when she wants the participants to inhale or exhale. In a lot of examples, some of them already provided, she describes verbally what they have to do (“inhale”), and just afterwards makes the sound of inhaling, exaggerating it so it can be audible. The same occurs with exhaling.
Cueing > Explanation > Non-Verbal > Change Plane

Depending on the exercise that the instructor is explaining, she shifts from a frontal plane (the theoretical plane that divides the body into a front part and a rear part) to a midsagittal plane (the theoretical plane that divides the body into a left part and a right part). This happens in two cases: in the first, the instructor is facing the participants (frontal plane) due to the fact that 1) she has been explaining an exercise where the main movements are performed in the frontal plane (images 19, 20, 21); 2) she is in the period between exercises and she is either speaking with the participants or providing an introduction to the exercise (images 22, 23, 24); or 3) she has been checking or correcting the participants, and therefore, facing them. In any case, we see a pattern: if the exercise that she is going to explain has the main movements in the midsagittal plane, she turns 90º to show the participants her side.

Images 19, 20, 21– In this case, in the first image, the instructor has just finished explaining the first part of a series of exercises to release the tension in the shoulders (described in cueing > explanation > verbal > reminder), and proceeds to explain the second part, which consists in adopting the position depicted in the second image, and bring back and forth the arms. Since this movement of back and forth is performed in the midsagittal plane, the instructor changes plane (third image).
Images 22, 23, 24 – In the first image, the instructor has finished to verbally introducing the elastic band, which they are going to use in the following exercise. Before start explaining the exercise (which is the example exercise for the subsection cueing > explanation > verbal > description), she changes her position to show the participants the midsaggital plane (second and third image).

Images 25, 26, 27, 28 – The instructor is checking the performance of the participants (first image), whom are performing a variation of the exercise described in cueing > explanation > verbal > shifting attention > 1, 2, 3 (same exercise without the bands). Once she is done checking them, and it's time to start a new exercise, she heads to the mattress (second and third image), and directly positions herself in a midsaggital plane, since the next exercise consists in laying on the back, raise both legs from the ground, without bending the knee, and perform what is known as 'scissors', raise one leg until it's in a 90° angle with the body, while the other remains in the same plane as the ground, and change legs.

On the second case, the instructor is showing the participants the midsaggital plane, as she has been explaining an exercise with the main movements on the midsaggital plane, and she turns 90° to face the students, in order to do one of the reasons stated above: start a new exercise, speak with the participants, or check/correct them.

Cueing > Explanation > Non-Verbal > modeling

The instructor performs the exercise, movement or position herself. When explaining an exercise, the vast majority of times she physically shows the participants how it is performed. This modeling occurs at the same pace that the participants implement the exercise, meaning that the instructor does not model the whole exercise previous to the participants implementation, but rather she splits up the exercise: she models the first movement while explaining it, and then waits for the participants to repeat that bit of the sequence.

One example of modeling is depicted in the different pictures below, which correspond, all of them, to the same exercise.
In the image 29, the instructor has just started the exercise, and is modeling the first position, which is bended knees and bent back. As it can be observed, the instructor models the exercise, at the same time that is describing it, as it has been previously stated (“find your seat bones, and at the same time, rounded back”, K.). Nonetheless, it is not until some few seconds later, when the instructor has modeled and described the exercise, that the participants adopt it (image 30). This encompasses a really small lapse of time, but this lag is going to be present in all the modeling explanations.
The instructor proceeds to model and describe the second step of the exercise (image 31) which is to bring the heels up to the chest (“tightening your belly, and this time we come up”, K.) and maintain the position, which can be better observed in image 32, where the participants are in the process of implementing it, and the instructor waits.

The next step of the exercise is to 'clap' with the feet, one against the other, roll back, roll forward, and stay in the same position. The instructor models and describes the rolling back (“roll back”), because for the clapping she utters a sound (see cueing > explain > verbal > sound) similar to the clapping of the hands. In the meanwhile, the participants maintain the previous position (image 33), and by the time the instructor finished the movement, some of the participants have already started to perform it (image 34).

There are several examples of modeling throughout the video, but they are instructed in the same way: instructor modeling, and waiting for the participants to catch up before moving on.

**Cueing > Explanation > Non-Verbal > Gesticulate**
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The instructor uses gestures with the hands during the description of a position or movement. The images below depict a sequence of different hand gestures that she performs while she is telling one of the participants a suggestion of improvement of a position of the legs, before starting the exercise, in order to avoid possible future problems (the whole suggestion of improvement can be found in feedback > correction > pre-correction).

**Cueing > Provide Alternatives**

The instructor, at different points, provides alternatives to the exercise. In the video it can be observed that sometimes, such alternatives are given to the participants before or at the beginning of the exercise. An example of this can be found in an exercise where the participants have to lay down, stretch one leg up into the air, with the help of the band (which is grabbed with the two hands, and pushed with the heel of the feet that is up) and make a movement. The instructor presents two options: “you can do a small, slow circle, or you can do a big, fast circle” (K.) (screenshots of this exercise can be found in cueing > explanation > verbal > shifting attention > images 1, 2, 3), although in this case she omits an explanation on why providing such an alternative. There are different outcomes in the participants, half decide to implement the small and slow circle, and the other half the big and fast circle.

Other times, the alternatives are presented during the exercise in the form of a suggestion, after the instructor has checked the students. An example of this can be found in the next images.

The students are performing an exercise that requires them to lay down on their back and have both head and neck, and legs up in the air, and the instructor suggests to use a hand as a helper of the head and neck in case they are feeling too much tension: “if you feel much tension in your neck (...) you can put a hand behind the head” (K.). In this specific case, nobody implements the suggestion.
4.1.2.2. **Feedback**

We found two types of feedback provided in the video analysis: *cheering up* and *corrections*. Regardless of the type of feedback, the questionnaire of the instructor reveals that what is important when providing feedback is “to help/make people feel the difference, and to make people feel good about themselves for making the effort. It is OK if it's not perfect” (K.), and that the instructor provides feedback “whenever I can” (K.).

Although not observed in the analysis of the video, the questionnaire also reveals that sometimes feedback regarding corrections is omitted. The instructor states that “Small changes can give a profound result, although not perfectly performed. Pilates was from the beginning named "The art of controllogy", and to do the exercises 100% correctly is often quite hard. If I was aiming for perfect performance, I believe that would take the fun and well being away. As long as no one is doing anything that might hurt them, I therefore adjust the level of correcting to what I see that the students can perform. When students attend regularly, then I increase the level little by little” (K.).

**Feedback > Cheering Up**

The instructor provides feedback with positive content to the participants regarding their performances. The instructor states in the questionnaire that when people do something correct she reacts by “crediting them! Letting them feel the difference”, which helps to “set the atmosphere of the class, making it a more fun class. It confirms (the) students that they are doing a good work, inspiring them to continue and keep on making the effort” (K.).

This kind of feedback is diverse, it can be found after finishing an exercise or after the implementation of a correction. According to the instructor, as she states in the questionnaire, she tries to provide this kind of feedback “as often as possible, to encourage and motivate them” (K.).

We have identified two moments in which this kind of feedback is provided. One one hand, the instructor provides this kind of feedback after the implementation of a correction by the participants. On the other hand, the instructor also provides this kind of feedback without any previous correction, just after checking the participants. In the next example, both can be found.
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This is an example of *cheering up* directed to a single person after a correction, and is illustrated with the following picture. In the exercise that the participants are performing (see the second example of cueing > explanation > verbal > imagery for full description of the exercise) they are expected to have their head resting on the mat. The two participants on the right (the one with the instructor in the image, and the one next to him) fail to keep the head in the mat at the beginning. The instructor, who is checking the participants, notices it for the participant more to the right, and provides a correction to him: “*put your head down on the mat, so you can take as much tension off the shoulders as possible*” (K.). Here it is interesting to notice how the participant who was having the same problem, but to which the correction was not addressed, corrects the position, unnoticed by the instructor, who is focusing on the other participant. This last participant then proceeds to rest his head on the mat, on which the instructor comments cheerfully: “*good!*”, and leaves to check the other participants orderly (from right to left of the picture). To another participant (the second starting from the left), the instructor again provides personal feedback: “*excellent!*”. And right afterwards, after briefly checking the last participant, she provides general feedback to all of them: “*excellent, class!*”, providing feedback without a previous correction, and just in basis to the performance.

But this kind of feedback is not limited to single words. In the same exercise, later on, when the instructor asks the participants to try to maintain their hips steady (see feedback / cueing > correction > non-verbal > mobilization) and they do, she utters: “*are you sure you've never done Pilates before? You must be natural talents!*” (K.).

**Feedback / Cueing > Correction**

We define *correction* as the actions, either spoken or not, through which the instructor provides an improvement of the exercise, movement or position to the participant. It is usually given after the performance of the participants, except in one instance where it takes the form of a pre-correction (see feedback / cueing > correction > pre-correction), and in the questionnaire, the instructor states that “I prioritize to address and correct areas/problems that tend to cause tension and sometimes pain” (K.).

The instructor also states in the questionnaire that the way she learns that she has to provide a correction is “*watching students, doing an analysis of how they work different muscles based on a deeper knowledge of physiology and anatomy*” (K.).
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We consider *correction* both part of *cueing* and *feedback*. It is part of *cueing* because it encompasses ways of instructing a person how to perform, and it is part of *feedback* because it is given regarding the performance of an exercise, movement or position on the participants' side that has to be improved.

It is also interesting to notice that such corrections are not always given to everybody, there can be provided to a single person or in general, as the instructor herself states in the questionnaire: “*(I provide) instructions both to the whole group and individually*” (K.). In the images below an example of this type of correction can be found.

In the image 43 the instructor has just told the participants to put the band below their armpits, but before starting to explain the exercise, one participant (the one on the right) does not have the band under the armpits. The instructor orients towards that participant and indicates so to him: “*put the band underneath your arms*” (K.), which he does (image 45), thus correcting the position.

An example of general correction can be found in feedback / cueing > correction > verbal > reminders.

As it will be observed next, the corrections are not always provided in the same way. The instructor states in the questionnaire that she provides correction according to “*the students needs, and varying during the class, so it does not get boring. When providing feedback in different ways, I believe that students assimilate from different angles*” (K.).

Last, but not least, although not observed in the analysis of the video, the instructor highlights in the questionnaire that the type of correction changes according to the level of the participants:
“beginners: more feedback about general body awareness; more advanced: more specific feedback about details for a correct performance” (K.).

Feedback > Correction > Pre-correction

We have observed in one instance that the instructor suggests a change in the position of one of the participants in base to the possible problems it may cause. We have called this pre-correction, given that it cannot be treated as a correction per se, since there has not been any implementation yet.

The example itself is depicted in the images below.

In image 46, the instructor has just finished explaining the initial position for the exercise that she is going to explain next, which requires to have straight back and bended knees. But before starting to explain the exercise itself, she notices one of the participants (image 47), and she describes another position for him: “I think that maybe you, if you feel that you’ll have to have your knees bend on the side, you should sit like this instead” (K.) because otherwise “you will have pain in the back of your legs” (K.). As it can be observed, she also models the new position. At the end of the explanation, all the participants adopt the new position (image 49), although it was intended solely to one participant.
Feedback / Cueing > Correction > Verbal > Description

As in explanation, the instructor provides a description of what has to be performed/changed. This is a common way of correcting. For instance, there is a moment where one of the participants has his head up in the air instead of laying it down, as it is supposed to be, and the instructor corrects him: “put your head down on the mat” (K.). A screenshot and a more detailed description of the exercise can be found in feedback > cheering up > images 42.

Feedback / Cueing > Correction > Verbal > Suggestion

The instructor poses the correction in a sort of suggestion, instead of in an imperative tone. There is one example of this type of correction in the same scene as illustrated in the previous section description. The first time that the participant faces this problem, of not resting the head in the mat as it is supposed to be, the instructor poses the correction as a suggestion: “your head can rest on your mat” (K.). He implements the correction, but as it has been previously observed, he makes the same mistake later on again, shortly after the correction.

Feedback / Cueing > Correction > Verbal > Reminder

Another way of providing a correction is to pose it as a reminder. There are instances in the video where it is observable that some students are performing something in an incorrect way. Instead of addressing the issue specifically, the instructor sends a general reminder.

In the images above, the participants are performing an exercise with the band. From the initial position that can be observed in the image, they are instructed to turn the torso left and right, encompassing it with the breathing. In the pictures three of them (except the second from the right) have their shoulders shrugged. While the instructor is modeling the exercise, she reminds the participants to: “keep(ing) your shoulders down” (K.). In this case, none of them implements the correction, as it can be observed in the image 51.
Feedback / Cueing > Correction > Non-Verbal > modeling

The instructor performs herself the exercise, movement or position to correct, in order to show the participants how it is done. There are few instances of this type of correction. One of them is the example mentioned in feedback / cueing > correction > images 46, 47, 48, 49, where the instructor tells one of the students to put the elastic band under his arms, and while saying so, she performs the same action herself (although she had the proper position).

Feedback / Cueing > Correction > Non-Verbal > mobilization

We define mobilization as the physical actions that the instructor performs upon a participant, touching them. It means that the instructor physically interacts with the participants to make them adopt a new position.

One example of mobilization is found in the video, which is depicted in the pictures below:

The participants in these images are performing the same exercise that as in the second example of in cueing > explaining > verbal > imagery. The instructor, after letting the participants perform the exercise for some time, poses the correction “hips as steady as possible” (K.). She goes to one of the participants and physically locks his hip so he cannot move, until he does it for himself, moment in which she lets go off him.

4.1.2.3. Request

The instructor actively asks for participants’ feedback from the participants through questions, usually after she has explained something about the exercise while they are performing it. For instance, there is a scene where she introduces an exercise (image 56) that is a variation of another one (image 55,
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description of the exercise can be found in cueing > explanation > verbal > shifting attention), the only difference between the two of them being that there is no artefact involved in the variation. She argues that without artefact, they have to work more with the belly, and ends the argumentation asking the participants: “do you feel it?” (K.). In this case, only one participant (left) answers negatively, to which the instructor insists: “no?”; and no more feedback from the participants is given.

Another example is found in the same exercise as depicted in feedback / cueing > correction > verbal > reminders, where they are performing torso rotations while tensing a band under their arms. The instructor (K.) is explaining to them that with the band they “add some extra strength”, which supposes more “work in the shoulders”, and finishes asking again: “can you feel it?”, to which the students do not reply verbally but by nodding their head.

All the requests observed in the video are of a similar nature, the instructor asking the participants whether they feel what she is explaining. Moreover, in all the instances observed, the participants always provide a positive answer.

4.1.2.4. Answer
We define as answer when the instructor replies to a question or an argument of a participant, and such reply does not come in the form of feedback over a performance (requested feedback), but as in the form of explanation. An example of this category is depicted in the images below.
The participants are performing an exercise that requires them to lay down, with bent knees in the air and the pelvis slightly posteriorly titled, so there is no space between the lower back and the mat (position known as ‘table top’), and start by touching their knees (participant on the left in image 57), then move the arms behind while extending the legs (image 58), and finally stay with both arms and legs stretched (image 59). The participant on the right, while performing it, asks if the exercise would not be better performed in another way, with the gluts on the ground, as the only point of support, and the back, legs and arms completely on the air all throughout the exercise, performing the same movement: “is it better to keep... I mean... even more like this?” (R.). At the same time, the participants models the exercise he means. The instructor then provides answers to the participants: “you mean another exercise. In this exercise you keep the back on the floor, except for the upper part and shoulders. The one you were doing is called teaser” (K.), and proposes the participants to try it “I mean, we can try it if you want” (K.), to which the participants answer positively, and they all proceed to try the new exercise.

4.1.2.5. Checking participants

The instructor performs visual observations of the participants, while they are performing the exercise, movement or position. Some of them are followed by feedback, whereas others are just plain observations.

Usually prior to the observations, the instructor has been explaining the exercise, modeling it. When the participants do it for themselves fluently, she stands up and goes closer to the students, checking them. The images below illustrate one of these moments.
The participants are performing the exercise described in *Answer*, while the instructor models it. At some point (image 61) the instructor stops modeling, stands up, and gets closer to the participants. During this process, she keeps instructing verbally: “try to keep your upper body as high as possible” (K.). By image 63, the instructor has already checked the participants, and proceeds to provide a reminder: “squeeze your abs as strong as possible” (K).

In the questionnaire, the instructor states *checking* as what helps her realize what is not working: “(*it helps me realize) watching students, and doing an analysis of how they work different muscles, based on a deeper knowledge of physiology and anatomy” (K).

4.1.2.6. **Use of Artefacts**

An important part of the activity is the use of artefacts in its practice. Although in the recorded class only one artefact is used, an elastic band, it will be observed later in the results, in the practitioners’ questionnaires, that multiple artefacts are usually used in Pilates classes. In the video, the instructor uses the elastic band with two purposes: as a help, and as a challenge.

**Use of Artefacts > Help**

With the introduction of the artefact, the instructor lowers the difficulty of the exercise, thus introducing a help to the performance. In the next image, the instructor has introduced the elastic band to the exercise, and she is modeling it for the first time (the description of this exercise can be found in the first example of cueing > explanation > verbal > description). While doing so, the instructor herself explains the helping role of the artefact to the participants: “*the band will help you to keep the legs as steady as possible*” (K.).
Some time after, the instructor removes the band from the exercise and makes the participants perform the same exercise without the aid of the band, as it can be observed in the image. The instructor emphasizes the helping role of the band once again: “when we don’t have the help from the band, you need more belly work, to keep it stable” (K.).

By the end of the exercises, the instructor insists once again on the role of the band: “that was an example on how to use the band to help us find the position, to assist” (K.).

**Use of Artefacts > Challenge**

In the second case, the instructor uses the artefact with the aim of making the exercise more challenging. Just right after the previous exercise, where she emphasizes the helping role of the band, she introduces the new exercises by saying: “and now we are going to use it (the band) the other way, we are going to use the band to (...) get more work” (K.).

As it can be observed in image 66, the instructor explains an exercise (described in feedback / cueing > correction > verbal > reminders) in which they rotate the torso with open arms. Once the participants have performed this exercise, she introduces the elastic band: “that was without the band, now we are going to use the band. Put it under your arms” (K.), and they proceed to perform the exercise with the band (image 67). The instructor (K.) emphasizes the challenging characteristic of the band, commenting that they “need to add some extra strength” to perform the exercise, which can be observed in the performances of the participants, some of whom stop to rest during the exercise.
4.2. PRACTITIONER’S PERSPECTIVE

In this section, we present the different practitioners’ perspectives. At the beginning we provide the resulting conceptual map of the analysis of the video. The map shows the categories that are linked to the participants, and how they are connected to each other. Following we describe and illustrate the categories, using them to present important sequences of the video. Such sequences usually revolve around an instance of the category, but longer sequences have been posed in the examples, to provide the reader with context. After the description of the categories we present the results of the analysis of the practitioners’ questionnaire.

Practitioners’ perspective map

4.2.1. Conceptual Map
The map presents the different categories, and the relations among them (bi directional relations), to which arbitrary colors have been attributed.

4.2.2. Explanation of categories
As in the instructor’s section, we will explore the categories top-down. The main categories (in dark blue in the map) will be presented: implementation, checking, provide feedback and request, and in
each of them the included categories will be explored (in green in the map), and examples will be provided regarding how are these categories characterized (in yellow and light blue in the map). The header of each category is designed to correlate to the map, and thus, try to clarify the relationships between categories. Moreover, some subcategories can be classified regarding if they are of a verbal or non-verbal nature, which is also stated in the headers.

4.2.2.1. Implementation

The category Implementation stands for the physical actions that a participant realizes. It means that they are performing an exercise, movement or position. In the video we have identified different types of events that trigger an implementation on the participants side. We have called these events initial and adaptation. Initial implies that the participants are implementing in their performance an exercise, movement or position for the first time, from an initial static condition. On the other hand, adaptation means that the participants implement a change in an exercise, movement or position that they are already performing, and this change has different triggers, as it will be further explained.

Implementation > Initial

In initial, the participants are yet to perform the exercise, movement or position. We found that what triggers an initial implementation of an exercise, movement or position is the explanation of the instructor.

Implementation > Initial > Explanation

Explanation stands for those actions, either spoken or not, of the instructor that trigger a change in the static initial condition of the participants. Different examples will be provided next, according to which type of explanation is found. We are going to divide once again the different types of explanation found into Different examples will be provided next, according to which type of verbal and non-verbal.

Implementation > Initial > Explanation > Verbal > Description

The instructor provides a description of the exercise, movement or position. One example of how a description triggers an implementation in the participants can be found in the example depicted in the images below.
In image 68 they have just finished one exercise, and the instructor is about to introduce the new one. She starts explaining the initial position of the new exercise and describes what to do to the participants: “ok, we are going to lay on the side, roll to the side” (K.), and the participants start moving to change position (image 69). Once the participants have moved their bodies, she keeps describing how to achieve this initial position: “now, on the side, with your knees bent” (K.). In image 70 it can be observed how the participants bend their knees, according to what the instructor has said.

**Implementation > Initial > Explanation > Verbal > Imagery**

Imagery, as a form of explanation, also triggers an implementation in the participants. Taking as an example the last one provided in cueing > explanation > verbal > imagery > images 6, 7, 8 (see for screenshots and detailed description), where the instructor tells the participants to “imagine that you have a tail that you are pulling forward, between your legs” (K., between image 71 and image 72), we can observe how the participants perform the movement once the instructor has used this form of imagery.

**Implementation > Initial > Explanation > Verbal > Reminder**

Reminders do also trigger a change to the initial condition of the participants. An example can be found in cueing > explanation > verbal > reminder, where the instructor reminds the participants about the 'neutral position' while explaining the exercise, and all of them implement the position.
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**Implementation > Initial > Explanation > Non-Verbal > modeling**

The instructor represents with her body how the exercise, movement or position is performed, and the participants try to imitate it. An extensive example of how modeling triggers an implementation can be found in cueing > explanation > non-verbal > modeling. There it can be observed how the instructor models a movement or position, and waits for the participants to implement it, whom do, shortly after the instructor has modeled it.

**Implementation > Adaptation**

In adaptation, the participants have already performed the exercise, movement or position, but they adapt it in basis to some factors, which are further explanation, space options, correction, and copy-cat.

**Implementation > Adaptation > Further Explanation**

There are cases in which the instructor does not provide the explanation of an exercise all at once, but rather explains a part of it, lets the participants implement it, and afterwards keeps further explaining it. We refer to this as further explanation. In this category we found that the instructor uses description and modeling as ways of keep explaining the exercise. We found that it is quite a common way of instruct the exercise. The images below depict an example of further explanation.

In image 73, the instructor is modeling an exercise, called 'the bridge', which consists in laying on the ground, with bent knees, and raise the gluts up to the air (as the instructor does in the image). Once she has explained this first step, she stands up and approaches the participants, and while checking, keeps explaining 'the bridge' (image 74). After some repetitions of the exercise, she presents a new take to the exercise: “now, next time we are going to make it a bit stronger, next time you are up to the bridge,
stay up there, stay up to the bridge, keep on breathing, and next time you exhale you are going to lift a foot, without dropping your butt” (K.). She provides this new explanation between image 75 and image 76, but both images have been included to depict, yet poorly due to the angle of the image, how the instructor not only describes the exercise but models it. In image 75, it can be seen that the instructor has her right foot on the ground, while in image 76, that feet is elevated. This matches the moment of the explanation where she is describing that they are going to lift the foot.

Implementation > Adaptation > Correction

We found that the participants adapt their movements and position to the corrections provided by the instructor, which are description, modeling, reminder, mobilization and suggestion. In feedback / cueing > correction can be found the different ways in which an instructor provides a correction, and in basis to which the participants implement the correction. In the same section, several examples of how the participants implement a correction are depicted. Moreover, as stated in such section, the corrections may be aimed at everybody or not, and may be implemented by the person whom the correction aims or by everybody.

Implementation > Adaptation > Copy Cat

We found that the participants do not only look at the instructor when she is explaining an exercise. They also check other participants and what they are performing, and adapt their movement or position accordingly. In the images below, which correspond to the first minutes of the class, the instructor has been explaining how to breathe (image 77), but changes to the hips and their position and she requests them to have the hands on the hips instead of the ribcage, as they had so far (image 78). As it can be observed, the participant on the left has made the transition from one position to the other. The other participant (right), who is looking at the instructor, checks the other student, and adapts his position (image 79).

4.2.2.2. Checking

Another role of the participants is what we have named checking. Unlike in copy-cat, where the checking of other participants triggers a change in the performance, we have named checking to a
more observational role, where the student checks the instructor (*check instructor*), other participants (*check participants*) check themselves (*check one self*), and check their options of space. This *checking* happens very frequently all throughout the activity, and can lead to implementations or not.

**Checking > Instructor**

Images 80 and 81 depict a checking of the instructor. In this case, the instructor is explaining the exercise, both describing and modeling it.

It can be observed the difference between both images. In image 80, the instructor is emphasizing the importance of the abs: “*tighten abs*”, and the participants are not checking her. On the other hand, in image 81, the instructor has just verbally introduced the new step of the exercise (without modeling it): “*and now, we raise the head*”. This second image is quite illustrative of how the participants are checking the instructor, since two of them (left) open their legs and raise their head, to look through their legs. Another one (third from the left) tilts his head to check the instructor as well. The instructor proceeds to model the next step.

**Checking > Other Participants**

An example of checking other participants can be found in the previous subsection (Implementation > Adaptation > Copy Cat), where a student checks another one, this time with the outcome of an implementation on his own performance.

**Checking > One self**

Whereas *check instructor* and *check participants* are performed visually, we found that the students check
themselves both visually and physically. The images below are extracted from the beginning of the class, where the instructor is teaching the basics of Pilates regarding breathing and positions. In images 82 and 83, the instructor has explained how to breathe: “we feel the ribs opening”, and the participant looks down to the ribs. In image 84, the instructor is tackling the neck position, and the participant physically checks herself.

Finally, the participants check the space before or during the performance of the exercise, and they have two ways to do so: visually and physically. In check visually, the participants look around their immediate space, before performing the movement, to see what is the available space; whereas in check physically, the participants check the space with a part of their body, in the instance shown, the arms.

The images (85, 86 and 87) show a participant checking visually the space options on her left side, where another participant is.

4.2.2.3. **Provide feedback**

The participants provide feedback on their performance and the class. This feedback can be requested or not.

**Provide feedback > Answer**

When the feedback is requested by the instructor, it comes in the form of a question. Thus, the way of providing feedback is verbally, with an answer. In one example, the instructor asks if they feel that the exercise that they are performing makes them work on the shoulders, to which they answer affirmatively. Examples of this category can be found in the request category of the instructor (1.4 Request).
The participants also express their opinions on an exercise freely, and thus providing verbal feedback on the exercise itself. This has been observed to happen when they find an exercise easy or difficult. For instance, the image 88 depicts an exercise where an example of an opinion is found. The participants are performing an exercise where they have to touch their ankles with the hands (touch, not hold), roll back, and come back to the initial position. While performing the exercise, one of the participants (I.) utters: “but it is easier, when the knees are closer”, to which the instructor replies “but I see a bit of cheating there”, referring to the fact that the mentioned participant is holding her ankles, instead of just touching them. Another participant proceeds to ask about the exercise, and the topic changes.

Another example of opinion is depicted in the images below.

The participants are performing the exercise that can be observed in the images. Getting their feet in the air in a lotus position (image 89), they are supposed to roll back (image 90), and come back to the original position. As can be observed in image 91, the participant on the left has problems when getting back to the initial position, and so she utters: “it's hard to come back” (I.), to which the instructor replies “yeah, that's usually, yeah, the toughest peak, to come back” (K.).

4.2.2.4. Request

We also found that the participants request further feedback and further explanation from the instructor. Although it is not a common practice in my observations, there are two examples of this category. In the first case, a participant requests further feedback on an exercise that he is performing: “but is it better to keep, I mean, even more like this?”. This is the same example as the one explained in 1.5 Answer (see for more details), where the instructor answers saying that what the participant is performing is, altogether, another exercise. (115) In the second case, request further explanation, the participants are performing an exercise that requires them to roll back on their backs and come back to
a 'static' position, where their legs are up in the air, supported by core work. Screenshots of this exercise can be found in the previous subsection provide feedback > opinion > image 88, in the last example. After one participant has stated that is quite difficult, another participant inquires about what to do once he has rolled back, either to come back straight away or maintain the position back: “are you supposed to stay? Or are you supposed to continue?” (S.), to which the instructor answers “oh you can stay a bit, and then come back” (K.).

4.3. **Analysis of the practitioners’ questionnaires**

The analysis of the questionnaires resulted in three themes of interest: artefacts, own body and perception of the instructor.

4.3.1. Artefacts

The questionnaires reflect the importance that the practitioners of Pilates give to the artefacts with which they have worked in their practices. In the questionnaires, the practitioners mention other artefacts that they have used in Pilates, besides the elastic band: small balls, giant balls (Bobath balls), bosu (half circumference, that is bouncy), hoop, dumbbells and the mirror. They grant different roles to the artefacts: amusement, motivation, challenge and help.

4.3.1.1. Amusement

The questionnaires reflect the amusement that arises with the use of the artefacts, due to errors or difficulty of using them. One practitioner argues that “el bosu provoca risas, ya que hay que mantener el equilibrio” (“the bosu makes us laugh, given that we have to maintain the balance”) (practitioner n°20). Another practitioner states that “el bosu i la pilota gegant costa d'utilitzar-los, i ens fa gràcia la dificultat de mantenir l'equilibri (bosu) o sostenir la pilota” (“the bosu and the giant ball are difficult to use, and it is funny for us the difficulty of maintaining the balance -bosu- or hold the ball”) (practitioner n°21).

4.3.1.2. Motivation

The practitioners find that the use of artefacts motivates them because it diversifies the activity: “així canvia una mica l'activitat” (“this way, the activity changes”) (practitioner n°8), “só un element
diferent als exercicis habituals” (“they are a different element to the habitual exercises”) (practitioner nº18). Moreover, they increase the entertainment of the exercise: “se hacen más entretenidos los ejercicios”, (“the exercises become more entertaining”) (practitioner nº15). Finally, they motivate the practitioners by being a challenge themselves: “(they motivate me because) they can make some moves more difficult” (practitioner nº22), “(they motivate me by) seeing if I can reach the goal of the exercise” (practitioner nº23).

4.3.1.3. Challenge
The practitioners find, in the use of artefacts, a challenge to their practice. One practitioner argues that “they can make some moves more difficult” (practitioner nº22), adding difficulty to the exercise. Another one argues that the challenge comes from having to learn to use them properly: “haig d’intentar utilitzar-los correctament i que em serveixin” (“I have to try to use them properly, and make them be of use) (practitioner nº22). For another practitioner, the challenge that the use of artefacts presents is that they require higher levels of concentration: “suponen más concentración” (“they suppose more concentration”) (practitioner nº7).

4.3.1.4. Help
As well as they represent a challenge, there are several ways in which the practitioners acknowledge how the artefacts help them. One of them is guidance: “they provide easier ways of activating the wanted muscles” (practitioner nº23). They also help the practitioners to assess their performance, what they are doing right and what they are doing wrong: “(lo hago bien) cuando forman parte de mi, una extensión de mi cuerpo” (“I am doing it right- when they become a part of me, an extension of my body”) (practitioner nº13); “em serveixen de referència (per saber si faig alguna cosa malament), si cau la pilota, si la banda no es tensa” (“I use them as a reference -to know if I am doing something wrong-, if the ball falls, if the band is not tense”) (practitioner nº14); “el espejo refleja tu posición y puedes comparar con la monitora” (“the mirror reflects your position and you can compare with the instructor”) (practitioner nº19).

Moreover, some practitioners reflect on how the objects help them to focus: “exigen más concentración al tener que utilizarlos” (“they require more concentration in order to use them”) (practitioner nº12). Another practitioner focuses on the physical aid that the objects represent: “m’ajuden a estabilitzar la postura” (“they help me to stabilize my posture”) (practitioner nº21).
4.3.2. Own body

The practitioners grant importance to their own physical reactions and proprioception during the activity, since they help them to know whether their movement or position is correct or not. They state to rely on the pain, proprioception, balance and effort as indicators of their performance. As examples, we pose illustrative answers of the practitioners to the question 'what tells you that you are doing an activity/movement correctly/incorrectly?': “si hago una postura mal, el dolor me indica que no lo estoy haciendo bien” (“if I am doing a posture incorrectly, the pain indicates me that I am not doing it properly”) (practitioner nº3), “la meva pròpia percepció de la postura o moviment” (“my own perception of the posture or movement”) (practitioner nº14), “el mantenimiento del equilibrio” (“maintaining the balance”) (practitioner nº13); “si no me supone esfuerzo es que no lo hago correctamente” (“if it does not require effort it is because I am doing it wrong”) (practitioner nº19).

4.3.2.1. Perception of the instructor

The practitioners also emphasize the instructor as a source to know about their performance and if they are doing it correctly or not, and there are several ways in which they do so. One of the ways is asking the instructor: “preguntando al profesor si lo hago correctamente” (“I ask the instructor if I am doing it properly”) (practitioner nº15). Another way is the cueing of the instructor: one practitioner, among others, states that she knows if the movement/position is correct through “las indicaciones del profesor” (“the indications of the instructor”) (practitioner nº9), another one states that she knows if “si noto en mi cuerpo aquello que la profesora dice que he de sentir” (“if I feel in my body that which the instructor tells me I have to feel”) (practitioner nº20). Another one poses that “el modelaje de la profesora”, (“the modeling of the instructor”) (practitioner nº12), indicates the practitioners whether they are performing correctly or not. Another way is through the feedback of the instructor. One practitioner states that she knows when she is performing incorrectly because “el monitor me lo indica” (“the instructor indicates me so”) (practitioner nº2).
5. FINDINGS

In this chapter we are going to present the findings of the study. The findings are going to be divided in two sections: in the first one, named Answering the research questions, we aim to answer the research questions based on the analysis of the results. In the second section, named Findings by themes, we are going to analyze some remarkable results, organized by themes, which we consider to provide insight on concepts that can inspire future technological interventions.

5.1. Answering the research questions

As stated in the Introduction chapter, our goal is to understand the elements involved in a working, co-located, social and instructed physical activity, which constitutes the research questions' scope. The sub-questions that the research question presented are: which are the elements involved? what are the roles of such elements? how are these roles characterized?

In order to answer the research questions and identify such elements, their roles and their characteristics, we perform the analysis as follows: we consider as an element those agents which actively execute a function in the activity; therefore, the roles of the elements relates to what functions do they perform; and the characteristics of the roles relate to the nature of such functions.

Bearing this in mind, we identify three elements that relate to the first research question: the instructor, the practitioners and the artefacts.

5.1.1. The instructor

The instructor is an element that executes several functions (roles) in the activity with different characteristics. In order to analyze which are such roles and their characteristics, we have opted to present two lists, the first one depicting the roles, what the instructor performs, and the second one depicting the characteristics of such roles, how the instructor performs it. As it can be observed, the roles and their characteristics relate to the categories that resulted of the video analysis, depicted in the map that can be observed in the chapter Results, under the instructor's result (Instructor's perspective conceptual map)
Thus, we can pose that the roles of the instructor are as following:

- **Providing cueing**: meaning provide an indication, signal, reminder or hint, either verbal or non verbal, to make a person perform in a specific way, which may be in the form of **explanation** (actions, either spoken or not, through which the instructor illustrates an exercise, movement or position, and/or explains how to perform it), **correction** (actions, either spoken or not, through which the instructor provides an improvement of the exercise, movement or position to the participant), or **providing alternatives** to the exercise.

- **Providing feedback**: which may be in the form of **corrections** or **cheering up** (feedback with positive content to the participants regarding their performances).

- **Requesting feedback** from the participants regarding their perception of the activity, mainly in terms of what they are feeling.

- **Answering questions or arguments** of the participants, but not in the form of feedback over a performance (requested feedback), but answering to questions about the activity or replying to opinions.

- **Using artefacts in the practice**: which are used either as a help to the exercise, making it easier to perform, or in order to challenge the participants, making the exercise more difficult.

Each one of these roles and their diverse forms are characterized by how the instructor performs them. Broadly speaking, it can be said that the main two characteristics of the roles of the instructors are whether they are performed / provided in a **verbal** or a **non-verbal** way, and the form in which is presented (for instance, the role cueing can be provided in several modalities: description, modeling, reminders, etc.). Therefore, we are listing the different characteristics of each of the roles next:

- **Cueing** is characterized diversely, regarding its forms, and we have classified them accordingly below.
  - **Explanation**
    - Verbal - there are several ways in which an explanation is provided verbally: through a description, a reminder, through imagery, by labelling and by shifting attention.
    - Non-verbal – there are three ways in which an explanation is provided non-verbally: by modeling, by changing plane, and by gesticulating.
  - **Correction**
    - Verbal - there are three ways in which a correction is provided verbally: through a description, a suggestion and a reminder.
    - Non-verbal – there are two ways in which a correction is provided non-verbally: by modeling and by mobilization.
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- **Providing alternatives**: the alternatives are provided either verbally, using *suggestion* and *description*; or non-verbally, employing *modeling*.

- **Provide feedback**. As stated before, the feedback can be *corrections* (characterized previously) or *cheering up*, which is provided verbally through different *utterances*.

- **Requesting, which** is characterized by being posed as *questions*, which are of a verbal nature.

- **Answering** is characterized by its *utterances*, obviously of a verbal nature.

- **Using artefacts in the practice** is more difficult to categorize, given that they are *acted upon*. Nonetheless, the instructor *describes* how to use the objects, which is of a verbal nature, and *models* how to use them, which is of a non-verbal nature.

As we have analyzed above, the roles (and their characteristics) of the instructor are multiple. We proceed to perform the same analysis with the next element: practitioners.

### 5.1.2. The practitioners

As the instructor, the practitioners also execute several functions (roles) in the activity with different characteristics. As in the previous element, the categories resulting of the video analysis stand for such roles and characteristics.

Nonetheless, we have included also a category that was not brought up in the video analysis, but in the analysis of the questionnaires for the practitioners instead. We refer to the inclusion of *knowledge through own body* as a role. Such aspect is not reflected in the resulting categories from the video analysis, but in the questionnaire. We present two lists, the first one depicting the roles, *what* the participants perform, and the second one depicting the characteristics of such roles, *how* the participants performs it.

We pose the roles of the practitioners as following:

- **Implementation**: physical actions that a participant realizes, which if are realized for first time we call them *initial*, whereas if they are modified in basis to a trigger we call them *adaptation*. The initial implementation is motivated by an *explanation*, whereas an adaptation is triggered by *further explanation* (when the explanation has been fragmented, and a part of it is provided after the initial implementation), *copy-cat* (imitate what the other practitioners are performing), *corrections* (corrections over the performance of the practitioners) and *own body*.

- **Checking**: observational role.
• **Providing feedback** about their performance and the class.

• **Requesting**: in which they request **further feedback from the instructor** or **further explanation**.

• **Knowledge through own body**: we refer as such to the knowledge that the practitioners gain of their performance through their own body.

Each one of these roles and their forms are characterized by how the participant performs them. As in the instructor's role analysis, there are two ways in which the roles can broadly be classified: **verbal** and **non-verbal**, and the form in which is presented. We are listing the different characteristics of each of the roles next:

• **Implementation**
  ◦ In **explanation** there are three ways in which the instructor explains that trigger an implementation in the practitioners: **imagery** and **description** as verbal ways in which it happens, and **modeling** as the only non-verbal.
  ◦ **further explanation** triggers an implementation in two manners, **description** (verbal) and modeling (non-verbal).
  ◦ In **copy-cat**, the **checking of other practitioners** is what triggers an implementation
  ◦ In **corrections** there are several ways in which a given correction triggers the implementation:
    - Verbal: **suggestion**, **reminder** and **description**
    - Non-verbal: **modeling** and **mobilization**

• **Checking** is characterized by its non-verbal nature. The practitioner may **check other practitioners** or **check the instructor**, both visually. Nonetheless, the practitioner may **check themselves**, which occurs visually and physically.

• The practitioners **provide feedback** verbally, by **answering** the questions of the instructor, or by providing their **opinion** regarding the exercise. Moreover, we emphasize the role of the practitioners of providers of feedback **per se**, just by performing, which provides feedback to the instructor about what they are doing correctly and what not.

• The practitioners verbally **request** further feedback from the instructor or further explanation.

• In **knowledge through own body** there are four ways in which the practitioners state that they gain knowledge on their performance: through the appearance of **pain**, their own **proprioception**, the **balance** and the **amount of effort** conveyed.
5.1.3. Artefacts

The last identified element are the artefacts. The results show different roles associated to the artefacts, from the perspective of the practitioners. We observed in the video that the instructor uses the artefacts in order to introduce an aid or a challenge to the exercise. We are presenting here the ways in which the practitioners state that the artefacts affect them in their practice, what is the perceived role of them.

There have been identified four roles of the artefacts, with different characteristics, which we are presenting next:

- **Amusement**: the artefacts have the role of serve as an amusement to the practitioners, due to fact that they may put the practitioners in 'awkward' or unfamiliar situations, in which they have to 'struggle' to perform, and it may lead to funny moments.

- **Motivation**: the artefacts also fulfill the role of motivating the practitioners. How the role motivates the practitioners is displayed in its characteristics, which are **diversifying** the activity, **entertaining** the practitioners, and **challenging** them, being this challenge a motivation.

- **Challenge**: the artefacts are found to have the role of challenge the practitioners, and this challenge is characterized by different aspects, such as **adding difficulty** to the exercise, having to **learn** how to use them, and **requiring more concentration** in order to use them.

- **Help**: the last role of the artefacts found is to aid the performance of the activity. The different ways in which an artefact help is by providing **guidance in the practice**, **aiding the assessment**, **facilitating focusing** and providing **physical aid**.

5.2. **FINDINGS BY THEMES**

In this section we are going to mention relevant findings regarding the results, grouped into themes.

5.2.1. **Role of artefacts**

The previously stated findings point out to different roles that the artefacts fulfill. Nonetheless, we would like to review some aspects that we find relevant. First of all, we would like to highlight the double function of the artefacts. The instructor may use them with a purpose (i.e. challenge the activity), which may be different from the way that they are perceived by the practitioners. As the activity unfolds, the practitioners find their own meaning and purpose of the artefacts, which might or might be not the same as the instructor's.
Among the different roles of the artefacts and their incidence on the practitioners, it is interesting to notice a dichotomy in such roles: the role of challenging the activity and at the same time, the role of helping, which at first appearance may look contradictory. However, the practitioners state both roles of the artefacts: one of the statements of the practitioners is that “they can make some moves more difficult” (practitioner nº22), whereas another statement reveals that “em serveixen de referència (per saber si faig alguna cosa malament)” (“I use them as a reference -to know if I am doing something wrong-) (practitioner nº14). This duality is due to how the instructor decides to use the artefacts in their practice. We observed that the instructor includes the artefacts in the practice both as a challenge and a help, consciously: in one exercise (see chapter 'Results > Instructor's perspective > Explanation of categories > Use of artefacts') she explains to the practitioners that “that was an example on how to use the band to help us find the position, to assist” (K.); but at the same time, the instructor also uses the objects to challenge the practice, stating that “we are going to use it (the band) the other way, we are going to use the band to (...) get more work” (K.).

The other roles stated by the practitioners (amusement and motivation) do not seem to have an observable effect in the class (regarding the results derived from the video analysis), neither the results show that the instructor uses them with such a purpose, but it is interesting to notice the feelings that these roles trigger in the practitioners. The practitioners find them amusing due to funny moments that can derive from the challenge of using them. As one practitioner states “el bosu provoca risas, ya que hay que mantener el equilibrio” (“the bosu makes us laugh, given that we have to maintain the balance”) (practitioner nº20), and as another practitioner poses “el bosu i la pilota gegant costa d'utilitzar-los, i ens fa gràcia la dificultat de mantenir l'equilibri (bosu) o sostenir la pilota” (“the bosu and the giant ball are difficult to use, and it is funny for us the difficulty of maintaining the balance - bosu- or hold the ball”) (practitioner nº21). This reveals that in some artefacts, a certain difficulty may lead to funny moments (problems in maintaining the balance, or hold the objects), which are regarded positively by the practitioners.

Moreover, the practitioners also find a motivation in using artefacts, on one hand because they enrich the activity by diversifying it and being entertaining: “són un element diferent als exercicis habituals” (“they are a different element to the habitual exercises”) (practitioner nº18), “se hacen más entretenidos los ejercicios”, (“the exercises become more entertaining”) (practitioner nº15). But also because they introduce a challenge to the activity, as one practitioner states: “(they motivate me because) they can make some moves more difficult” (practitioner nº22).

This points out to the possibility that the challenging role of the artefacts do not only result in a challenge in the exercise, but can also lead to amusement and motivation. It may present the
practitioners with an excuse to perform 'awkward' movements, which otherwise could be taken seriously, and this can lead to funny situations that the practitioners regard positively.

Besides the roles of the artefacts, it is also interesting to notice how artefacts present in the class, such as the mats and the mirror, are not regarded by the practitioners, neither in the results of the video analysis neither specifically in the results of the questionnaires. We think that one possible explanation of this absence of mention could be that the practitioners regard both mats and mirror as part of the scenario where the activity takes part, rather than artefacts with which they interact actively.

5.2.2. Differences in roles and characteristics among the element instructor and the element practitioners.

In the first section of the findings, we illustrated the different roles and characteristics for each element. As it can be observed, there are some aspects of them that appear both in instructor and in practitioners, given that both elements are deeply connected to each other, and some roles of one element are result or trigger of roles of the other element (for instance, the role requesting of the practitioners is related to the role answer of the instructor). By that we mean the role of the instructor of providing explanation. As it can be seen in the practitioners section, the explanation of the instructor triggers some cases of implementations. But it is interesting to notice that not all the ways in which the instructor provides an explanation do trigger an implementation, in comparison, for instance, to correction, in which all the ways in which a correction is provided do trigger an implementation.

For providing an explanation, the instructor uses several ways: description, imagery, reminder, labelling and shifting attention for verbal ways, and modeling, changing plane and gesticulate for nonverbal. Nonetheless, as it can be observed, out of all these different ways in which the instructor provides an explanation, only description, imagery, reminder and modeling do actually trigger an implementation (see chapter '4. Results > 4.2. Practitioners' perspective > 4.2.2. Explanation of categories > 4.2.2.1 Implementation > Initial > Explanation' and '4. Results > 4.2. Practitioners' perspective > 4.2.2. Explanation of categories > 4.2.2.1. Implementation > Adaptation > Further explanation' for diverse examples). All the rest do not trigger any implementation. We consider these aspects (which do not trigger any implementation) to help to provide, along with the others, a rich explanation of the activity, striving for clarity. We argue that labelling endows the exercise with context, as it will be further developed in '5.2.5 Creating a common language'; shifting attention makes the practitioners focus of certain areas of their body in which the exercise concentrates (in basis to a statement of the instructor “and now, let’s focus on what’s happening down in your hips” (K.), found in
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4. Results > 4.1. Instructor's perspective > 4.1.2. Explanation of categories > 4.1.2.1. Cueing > Explanation > Verbal > Shifting attention'); changing plane aids the explanation by showing the participants the plane where the main movements are performed (see '4. Results > 4.1. Instructor's perspective > 4.1.2. Explanation of categories > 4.1.2.1. Cueing > Explanation > Non-verbal > Changing plane'); and gesticulate is used as support to another type of explanation (as it will be further developed in '2.5.4 Striving for clarity > Merged Techniques).

5.2.3. Feedback

Feedback is an interesting theme that we are going to review profusely.

5.2.3.1. Types of feedback identified

In basis to the results, we identify in the activity the two types of feedback that we reviewed in the background. The category that we name cheering up in the results is related to what is known as promotion-oriented feedback, a type of feedback that aims at encouraging the performance executed (Carpentier & Mageau, 2013). On the other hand, we also identify change-oriented feedback, what we name in the results correction, the kind of feedback that aims at changing some aspects of the performance (Carpentier & Mageau, 2013).

5.2.3.2. Promotion-oriented feedback

As stated above, this kind of feedback aims at encouraging the performance executed. The results regarding the questionnaire of the instructor support it. As the instructor states in the questionnaire, she provides this kind of feedback to “help/make people feel the difference, and to make people feel good about themselves for making the effort. It is OK if it's not perfect”, to “credit(ing) them! Letting them feel the difference” (K.).

In the results, the instructor states that she provides promotion-oriented feedback “as often as possible, to encourage and motivate them” (K.). Nonetheless, we identify three distinct situations in which this type of feedback is given: after a correction is provided, after checking the implementation of the participants (without any correction given), and even after a not totally successful implementation of an exercise. Moreover, the feedback provided can be in the form of single words (“Excellent”, “Good!”), or full utterances (“are you sure you've never done Pilates before? You must be natural talents!”). Examples of all of them can be found '4. Results > 4.1. Instructor's perspective > 4.1.2. Explanation of categories > 4.1.2.2. Feedback > Cheering Up'.
According to the results, this kind of feedback is used to create a nice environment (as the instructor states “set the atmosphere of the class, making it a more fun class”), and to reassert the students about their performance and motivate them to keep on (“it confirms (the) students that they are doing a good work, inspiring them to continue and keep on making the effort”, K.). Change-oriented feedback

The other type of feedback is change-oriented feedback, aiming at changing the performance of the practitioners. In the background we reviewed the importance for this feedback of being autonomy-supportive, and the four characteristics of an autonomy-supportive feedback (Carpentier & Mageau, 2013). The findings reveal that the feedback provided is indeed inclined towards being autonomy-supportive: in some cases, the feedback includes foundation to why the behaviour should be changed (for instance, in '4. Results > 4.1. Instructor's perspective > 4.1.2. Explanation of categories > 4.1.2.2. Feedback > Correction > Pre-correction' can be found an example of this, where the instructor explains why the change of position will be beneficial, “I think that maybe you, if you feel that you'll have to have your knees bend on the side, you should sit like this instead, (otherwise) you will have pain in the back of your legs” (K.). The change-oriented feedback is also found autonomy-supportive in the sense that it considers the practitioner's perspective (takes into account their feelings and difficulties, (Carpentier & Mageau, 2013). The instructor states this concern for the practitioner's needs, and with her feedback she “prioritize(s) to address and correct areas/problems that tend to cause tension and sometimes pain”, focusing on the well being of the practitioners. The instructor also shows consideration for the practitioners state by adapting the kind of change-oriented feedback she provides, according to their level: “beginners: more feedback about general body awareness; more advanced: more specific feedback about details for a correct performance” (K.).

Finally, the feedback provided also proves to be inclined towards being autonomy-supportive because it is provided in a non-controlling communicating style. The controlling communication style includes shaming, conditional regards and threats of punishment (Carpentier & Mageau, 2013), none of which is present in any of the feedback provided. There is, though, a characteristic of autonomy-supportive feedback that is not present: providing choices of solution. We do not find any instance where it can be chosen among different solutions but, in any case, we consider the feedback provided to be inclined towards being autonomy-supportive.

This change-oriented feedback is provided in several ways. As previously stated, the instructor provides it through description, suggestion and reminder as verbal ways, and modeling and mobilization as non-verbal, and all of them are seen to trigger an implementation in the practitioners (for examples, see ‘4. Results > 4.1. Instructor's perspective > 4.1.2. Explanation of categories > 4.1.2.2. Feedback > Correction' and ‘4. Results > 4.2. Practitioners' perspective > 4.2.2. Explanation of categories > 4.2.2.1. Implementation > Adaptation > Correction’). The instructor provides in the
questionnaire foundation to why to diversify the type of correction: “(I provide feedback according to) the students needs, and varying during the class, so it does not get boring. When providing feedback in different ways, I believe that students assimilate from different angles” (K.). This points to the need of taking into account the students needs (which relates to being autonomy-supportive) and diversifying the type of feedback provided, both for the sake of variety and for assimilation.

Moreover, it is not only important how this type of feedback is provided, but also to whom and when it is provided (Carpentier & Mageau, 2013).

The results review that this type of feedback is given in three scenarios: after a wrong implementation, prior to a possible wrong implementation and what we call 'distributed'. In general, as it can be observed in '4. Results > 4.1. Instructor's perspective > 4.2.1. Explanation of categories > 4.1.2.2. Feedback > Correction', the change-oriented feedback is aimed at correcting a performance, but we also identify what we call pre-correction. In the example found in '4. Results > 4.1. Instructor's perspective > 4.2.1. Explanation of categories > 4.1.2.2. Feedback > Correction > Pre-correction', it can be observed how the instructor, prior to the exercise, suggests a correction of a position, to avoid future “pain in the back of your legs” (K.). We argue that this instance reflects a pre-correction, a correction that is given in order to avoid further problems, but it also reflects a knowledge of the instructor about anatomy and physiology. As the instructor states in the questionnaire, she learns when a person is performing something incorrectly by “watching students, doing an analysis of how they work different muscles based on a deeper knowledge of physiology and anatomy” (K.). In the example given, an assessment of the initial position of the participant may have lead the instructor to provide such pre-correction. This finding is in line with what McNeill (2011) states about how Pilates instructor assess the people in the class: “most of the time it is about asking (...) questions and seeing them walk, but from a Pilates point of view, it is once they start the movement of the basic exercises that a teacher starts to get feedback...The body never lies, no matter what they write on their form or ‘forget’ to tell you. You immediately see it, the evidence of that rotator cuff tear, the past ankle injury...” (K.). This quote illustrates an interesting aspect as well, worth mentioning, which is how the practitioners are sources of feedback just by performing and attending the class. According to the response to the questionnaire above quoted and McNeill's quote, the practitioners' body provides feedback on their anatomy, which the instructor can use in the class.

The third scenario, what we call 'distributed', stands for those corrections that, although being known forehand, are not provided immediately. We find an example of this in the results ('4. Results > 4.1. Instructor's perspective > 4.2.1. Explanation of categories > 4.1.2.2. Feedback > Correction > Non-Verbal > mobilization'), where the instructor permits the participants to perform the exercise, and after
they have performed it few times, poses the correction: “hips as steady as possible” (K.). This correction could have been provided from the beginning, as an explanation, but the instructor decides to let the participants perform some times before correcting the movement. We argue that one possible explanation for this distribution of the correction could be that the instructor adjusts the correction to the level of the participants. As the instructor states in the questionnaire, “to do the exercises 100% correctly is often quite hard (...) I adjust the level of correcting to what I see that the students can perform” (K.).

The next important issue to address is to whom this type of feedback is provided and who implements it. The results show that change-oriented feedback is provided to the group as a whole and to individuals (see ‘4. Results > 4.1. Instructor's perspective > 4.2.1. Explanation of categories > 4.1.2.2. Feedback > Correction’), which is also supported by the instructor's response in the questionnaire: “(I provide) instructions both to the whole group and individually” (K.). Regarding who implements the feedback, we have observed in the results that when the correction is aimed at somebody personally, there is an implementation of the correction (see ‘4. Results > 4.1. Instructor's perspective > 4.2.1. Explanation of categories > 4.1.2.2. Feedback > Correction > Verbal > Suggestion’ and 'Results > Instructor's perspective > Explanation of categories > 2.3 Feedback > Correction > Verbal > Suggestion’, for examples of this); with general corrections, and depending on how the correction is given, the participants may not implement it. For instance, there is an example (4. Results > 4.1. Instructor's perspective > 4.2.1. Explanation of categories > 4.1.2.2. Feedback > Correction > Verbal > Reminder’) where the participants are reminded to “keep your shoulders down” (K.), since they are not doing so, but nobody implements the correction. Finally, there is also the case where the change-oriented feedback is given to an individual specifically, but other people implement it. There are two cases in the results, the one described in pre-correction, where the instructor provides a pre-correction to a participant, but all the participants implement it (see ‘4. Results > 4.1. Instructor's perspective > 4.2.1. Explanation of categories > 4.1.2.2. Feedback > Correction > Pre-correction’); and the case illustrated in 4. Results > 4.1. Instructor's perspective > 4.2.1. Explanation of categories > 4.1.2.2. Feedback > Cheering Up’, where the instructor provides a correction to a participant (“put your head down on the mat, so you can take as much tension off the shoulders as possible”, K.), and another participant, who was facing the same problem but whom the instructor did not notice, implements the correction that he has overheard.

Finally, it is also interesting to notice how sometimes the corrections are omitted altogether. The instructor states in the questionnaire, regarding this matter, that “to do the exercises 100% correctly is often quite hard. If I was aiming for perfect performance, I believe that would take the fun and well
being away. As long as no one is doing anything that might hurt them, I therefore adjust the level of correcting to what I see that the students can perform” (K).

We have so far reviewed which are the types of feedback provided and how it ties back to theory; we have posed findings regarding how, when and to whom the feedback is provided, and who implements it. Last, but not least, we are going to mention the helping role that the feedback provided has for the practitioners.

5.2.4. Striving for clarity

In this sub section we have grouped some aspects that illustrate how the instructor provides explanations and corrections that we consider to have an aiding function, 'making things clearer', besides their actual role. We do not imply that any of the other roles or characteristics do not aim for clarity, or that are not provided with the goal of being as clear as possible, but rather we argue that the following aspects here presented can be considered to be distinctively striving for clarity, to make the practice more understandable, either because there is a change in the performance of the instructor that helps to clarify the exercise, because the instructor's supports her cueing by evoking images and using sounds, or because she uses more than one technique to provide her cueing. Most of the examples pointed out below can be found under the corresponding subcsections in '4. Results > 4.1. Instructor's perspective > 4.2.1. Explanation of categories > 4.1.2.1. Cueing'. In order to avoid redundancy, we point directly to the subsections found in the route above stated. Those examples that can not be found in the same route are stated with the corresponding one.

5.2.4.1. Change plane

As it can be observed in the results (see 'Change plane'), the instructor realizes a change of plane in two situations: when the instructor faces the participants (thus showing them the frontal plane) when she has been explaining an exercise where the main movements are performed in the frontal plane, because it is the period between exercises, where she speaks with the participants or because she is performing a checking or corrections to the participants; or the second situation, where the instructor is showing the participants the midsaggital plane, and changes to start a new exercise, speak with the participants, or check/correct them.

We identify in these changes of plane a movement pattern regarding which plane the instructor uses in each situation. We consider that showing the participants the plane where most of the action of the exercise she is explaining happens is more illustrative for the participants, the exercise is presented in
a clearer form, and they can better understand certain movements that, if presented in the other plane, would be more confusing.

5.2.4.2. Sound
Sound (see examples in ‘Sound’) is a characteristic of explanation, one of the ways how an explanation is provided. The fact that it is never provided on its own, but along other modalities, leads us to understand it as a clarification of the action that is to be performed, and at the same time, make the participants aware of the action being performed. For instance, there is the case where the instructor utters a sound for illustrating the action of inhale and exhale, an action that can not be appreciated visually on its own otherwise. This finding is in line to what Thomson (2013) states: “the vocalizations are added to draw more awareness to the breath, to bring more focus to the work in the present moment” (K.).

5.2.4.3. Imagery
Imagery is a very interesting way of providing feedback, since it consists in creating images in the practitioners head that can help them understand better an exercise (for examples, see ‘Imagery’). In the results there can be identified three ways of using imagery. The first, referring to positions culturally associated with feelings, which we consider to be instructing a position by similarity, finding an equivalent of the position with which the practitioners can easily understand, even if roughly, what the aimed position looks like (asking for a ‘proud position’ when a straight back is required).

The second way of using imagery involves telling the participants what they should be feeling or make the participants imagine a situation that can be understood as an allegory of the movement. It is pointed out in one of the responses to the questionnaire that providing this kind of explanation could have a double function for the practitioners, as one practitioner states, regarding how she learns that she is performing something properly, “no to en mi cuerpo aquello que la profesora dice que he de sentir” (“I feel in my body that which the instructor tells me I have to feel”) (practitioner nº20). Providing a kind of explanation with cueing to what the practitioners should be feeling can be used as an assessment tool for the practitioners themselves.

The third and last way of using imagery consists in making people imagine a situation that serves as an allegory of the movement that the instructor wants the participants to perform. An example of this type of imagery can be found in the results, where the instructor makes the participants imagine that they “have a tail that you are pulling forward, between your legs” (K.). Literature points to the possibility that these kind of explanation may help to avoid being repetitive in providing an explanation: “away
from repetitive demonstrations, (...) choosing to give precise directions for each movement such as "tuck your chin like an angry turtle" (Thomson, 2015).

5.2.4.4. Merged techniques
In the results we have identified that several times, when providing a correction and providing an explanation, the instructor does not rely on a single way of doing so, but rather merges different techniques with description. We regard this merging of techniques to be a way of striving for clarity as well: the explanation or correction becomes richer, it is supported by different techniques, and may give the practitioners a broader scope, as the instructor, for instance poses in the questionnaire “when providing feedback in different ways, I believe that students assimilate from different angles” (K.).

There can be found multiple examples of combinations of merged techniques, which we list next.

- **Modeling + description**: one of the most usual cases of merged techniques, the instructor combines a verbal description to what she is modeling, at the same time. An illustrative example can be found in 'Description', where the instructor can be observed modeling an exercise, and at the same time, describing it verbally.
- **Gesticulate + description**: gesticulate is not provided on its own, but rather it is used support the description. An example can be found in 'Gesticulate'.
- **Labelling + description**: labelling is included amidst a description, as it can be observed in 'Labelling'.
- **Labelling + description + reminder**: similarly, a label is also used alongside a reminder and a description, as it can be observed in 'Reminder'.
- **Imagery + description**: imagery is merged with the description of the exercise. An example can be found in 'Imagery > image 5'.
- **Imagery + description + modeling**: it exists this other combination of techniques, which includes also modeling. An example can be found in 'Imagery > image 4'.
- **Reminder + description + modeling**: the reminder has been found to be provided along a description and modeling, and not alone. Example of this can be found in 'Reminder'.
- **Sound + description**: Along a description, the instructor may include sounds to back up the description. See 'Sound' for examples.

5.2.5. Creating a common language
In the results, we can observe how the labels are used. In labelling ('4. Results > 4.1. Instructor's perspective > 4.1.2. Explanation of categories > 4.1.2.1. Cueing > Explanation > Labelling'), the instructor provides to the participants the name of the exercises or positions. When later in the activity she wants to instruct the same exercise or position again, she relies on the name, meaning that instead
of explaining it again, she says the label to let the participants know what they have to do ('4. Results > 4.1. Instructor's perspective > 4.1.2. Explanation of categories > 4.1.2.1. Cueing > Explanation > Reminder'). We understand this phenomenon as a technique for creating a common language between the instructor and the participants, a way of annotating a description, which allows the instructor to come back to such annotation when referring to already explained positions or movements. By annotating a description, the instructor 'saves time' and maintains the attention of the participants on the rest of the explanation, since once the participants know their name and what they refer to, they do not require too much attention to understand them.

5.2.6. **Style of instructing**

In the Background chapter we reviewed how there were different instructing styles (Mosston & Ashworth, 2002; Carpentier & Mageau, 2013) and how the instructing style had an incidence on the practitioner (Carpentier & Mageau, 2013). The different styles that we reviewed are, on one hand, the division proposed by Carpentier and Mageau between an autonomy-supportive instructing style and a controlling style. On the other hand, there are the division proposed by Mosston and Ashworth, who introduce up until eleven teaching styles, three of which we reviewed.

Regarding Carpentier and Mageau division, we have already stated in this chapter, under the section 'Feedback', how the way of providing feedback pointed towards an autonomy-supportive instructing style. Moreover, there are no instances in the results that may indicate a controlling style, such as pushing the practitioners to feel and think in a specific way (Deci & Ryan, 1985; Carpentier & Mageau, 2013), or rely on shaming, conditional regard and threats of punishment.

Regarding Mosston and Ashworth's framework of instructing styles, the three styles that we reviewed are the commanding style (decisions are made by the instructor, the practitioners follow him or her, who also provides general feedback while commanding), the practice style (instructor shows the practitioners what is to be performed, and while they are performing it, he or she checks them and provides feedback) and the inclusion style (the practitioners are offered different options and/or levels of difficulty from which to choose).

The findings reveal that, unlike in approaches such as Byra, Sanchez and Wallhead's (2013) (see chapter Background for more insight), where the three styles are treated individually in the practice, elements from the three instructing styles can merge and be present in the same activity. We argue that the results show traits related to commanding style, for instance, in the cases where the instructor is modeling and describing the activity at the same time that the participants do (an example can be found in '4. Results > 4.1. Instructor's perspective > 4.1.2. Explanation of categories > 4.1.2.1. Cueing > Explanation > Description'), and also the instructor provides feedback while modeling and
instructing the exercise, as it can be observed in an example found in 'Reminder', where she provides a correction in the form of a reminder without stopping modeling the exercise.

We also argue that the results show the usage of the practice style, where the instructor explains the exercise and then checks the students and provides feedback (without performing the exercise with them). An example of this type of instructing style can be found in '4. Results > 4.1. Instructor's perspective > 4.1.2. Explanation of categories > 4.1.2.2. Feedback > Cheering up', where the instructor walks around the participants, checking them, and provides both change-oriented feedback (to one participant) and promotion-oriented feedback (to a single participant and to the class in general).

Finally, we also identify elements of the inclusion style when the instructor provides alternatives to the exercises. Although the instructor does not actively state that the different alternatives represent different levels of difficulty, there are still two options from which the participants can choose, which makes us consider it as a pointer to the inclusion style (examples of providing alternatives in 'Provide alternatives').

We, therefore, state that we identify a mixture of all three instructing styles in the same class, revealing the complexity of the activity, showing that they can coexist in the same activity.

5.2.7. **Interaction between instructor and participants**

We have identified diverse situations regarding the instructor and the participants that help to draw the scope of the social interactions that occur during the activity.

The more obvious interaction between instructor and participants is the one that occurs through the performance of the exercises. The instructor explains an exercise, which the participants implement, and the instructor may or may not provide feedback about the implementation.

But despite this common form of interaction (action-response), there is also a more personal form of interaction, which we pose as the kind that requires some sort of conversation between the instructor and the participants. The results show that there is always an open channel of communication between the two elements, which is illustrated in their roles. The instructor has two roles who address specifically this type of interaction: request feedback and answer the participants. Similarly, the participants have also two roles, providing feedback to the instructor (upon request or by their own will, in the form of an opinion) and request from the instructor, either further feedback or further explanations. Examples of these roles can be found in the results: '4. Results > 4.1. Instructor's perspective > 4.1.2. Explanation of categories > 4.1.2.3. Request / 4.1.2.4. Answer' and in 4. Results >
4.2. Practitioners' perspective > 4.2.2. Explanation of categories > 4.2.2.3. Provide feedback / 4.2.2.4. Request'.

Specially interesting in this open channel of communication is the fact that the participants not only initiate the communication by asking for further information about their performance, but do also initiate the communication to express their opinion, upon which the instructor will comment in their response.

Another situation that exemplifies the interaction between instructor and participants is particularly interesting due to the fact that the instructor modifies the class in basis to the question of one of the participants. In '4. Results > 4.2. Practitioners' perspective > 4.2.2. Explanation of categories > Answer, one participant asks about how is better to perform an exercise, to which the instructor replies that he means another exercise, that “we can try it if you want” (K.), upon which she proceeds to instruct the new exercise. In this instance, a question of a participant has triggered a change in the design of the class, by including a new exercise. We believe this is relevant to illustrate the potential of the participants to actively shape the class, beyond the instructor adapting the level of the exercises to their level of skills.

As a final note, the interaction among the practitioners is not reflected in the results and thus, not included in the findings, although the importance that literature gives to it (see Introduction chapter).

We will further discuss this in 7. Conclusion > 7.2. Limitations and future work.

5.2.8. Checking: assessment and observation

In basis to the results, we consider that the role checking can have both the function of assessment and simple observation. In the case of the instructor, the checking that she performs has an assessing role. As the instructor states in the questionnaire, “watching students, and doing an analysis of how they work different muscles, based on a deeper knowledge of physiology and anatomy” (K.) is what helps her realize what is not working in the performance. This assessment can lead to provide feedback (see ‘4. Results > 4.1. Instructor's perspective > 4.1.2. Explanation of categories > 4.1.2.2. Feedback > Cheering Up’) or not (see ’4. Results > 4.1. Instructor's perspective > 4.1.2. Explanation of categories > Checking’), and keep going with the course of the activity.

In the case of the practitioners, we identify the checking to fulfill both an assessing and an observational function. As previously stated, a participant may check the instructor, other participants, or themselves. If the checking is performed with an assessing goal, it may lead to an adaptation of the implementation (see ‘4. Results > 4.2. Practitioners' perspective > 4.2.2. Explanation of categories > 4.2.2.1. Implementation > Adaptation > Copy-cat’). However, it could also be that the assessment
reaffirms the practitioners about their performance, and do not trigger any implementation. Checking can also imply an observational role, as depicted in ‘4. Results > 4.2. Practitioners’ perspective > 4.2.2. Explanation of categories > Checking’.

5.2.9. Distributed explanation
We have observed that, along with distributed corrections, the instructor also distributes the information throughout the exercise. An example can be found in ‘Results > Instructor’s perspective > Explanation of categories > Cueing > Explanation > Description’, where it can be observed how the instructor introduces an exercise (‘bridge’) and lets the participants implement it, and some time after, the instructor keeps explaining the exercise, without stopping, including a change to the performance (‘bridge’, but raising a leg). This illustrates that the information is distributed along the exercise, and that variations of an exercise are included in the explanation.

5.2.10. “How to know if I am doing it right?”
We have grouped under this theme the different manners, according to the results of the practitioners’ questionnaire, in which the practitioners get to know about their performance. We have identified three manners in which the practitioners get information about the performance. One is through the instructor, by asking them actively (“pregunto al profesor si lo hago correctamente”, “I ask the instructor if I am doing it properly”) (practitioner nº15); through their indications (“lo sé a través de las indicaciones del profesor”, “I know through the indications of the instructor”) (practitioner nº9); by the modeling of the instructor (“el modelaje de la profesora”, “the modeling of the instructor”) (practitioner nº12); and by noticing in their body what the instructor tells them they are supposed to feel (“notar en mi cuerpo aquello que la profesora dice que he de sentir”, “feel in my body that which the instructor tells me I have to feel”) (practitioner nº20).

Another way they know is through their own body, through their perceptions: “si hago una postura mal, el dolor me indica que no lo estoy haciendo bien” (“if I am doing a posture incorrectly, the pain indicates me that I am not doing it properly”) (practitioner nº3); “si no me supone esfuerzo es que no lo hago correctamente” (“if it does not require effort it is because I am doing it wrong”) (practitioner nº19).

Finally, the last form in which they know about their performance is through the artefacts they are using, in case that the exercise includes them, referring not only to the artefacts that they use in their practice (“lo hago bien- cuando forman parte de mi, una estensión de mi cuerpo”, “I am doing it right- when they become a part of me, an extension of my body”) (practitioner nº13), but also the
artefacts they do not use actively (“el espejo refleja tu posición y puedes comparar con la monitora”, “the mirror reflects your position and you can compare with the instructor”) (practitioner nº19).

In this chapter we have presented the findings of the study, organized in two blocks: first, we have provided an answer to the research questions based on the analysis of the results. Secondly, we have reviewed some themes that we found relevant to mention, with the aim of providing an incising picture of the activity as a whole, reflecting themes that we deem relevant as inspiration for future technological interventions in a similar activity.
6. DISCUSSION

In this section we are going to discuss the results of the analysis in relation to the research questions. Secondly, we are going to discuss how our findings relate to theory and related work and finally, we are going to propose some possible implications for future design interventions.

6.1. Findings and research questions

The analysis of the results has provided an holistic view into this kind of activity as well as answers to the research questions of the study, which scope was to understand the elements involved in a working, co-located, social and instructed physical activity. The research questions are:

1. Which are the elements involved?
2. What are the roles of such elements?
3. How are these roles characterized?

Regarding the first research question, we have identified, through the analysis of the results, three elements (instructor, practitioners and artefacts) involved in this type of activity.

Regarding the second research question, what do the elements perform, the findings also reveal the roles of such elements. For the instructor, the roles observed are cueing (with its different forms: explanation, correction and providing alternatives), provide feedback (with the forms corrections and cheering up), requesting, answering, and using artefacts in the practice.

For the practitioners, the roles are implementation, checking, providing feedback, requesting (both further feedback and further explanation), and knowledge through the own body.

For the artefacts, the roles are amusement, motivation, challenge and help.

Finally, regarding the third research question, how are these roles characterized, the findings reveal several characteristics of each role, which broadly speaking can be classified into whether they are of a verbal or non-verbal nature. A complete list of the characteristics, as well as explanation of the roles, can be found in the previous chapter.
6.2. Binding with theory and related work

In the chapter Background we pose that we use Mueller et al.’s framework (2010) as a tool to assist the research, and inquire about it. But not only the framework inspired our way to look into activity. We use the framework to review the findings of the study, since they can be related to the three perspectives (lenses) of the framework that we used: the moving body, the sensing body and the relating body.

The moving body takes into account the movements of the practitioners, the muscular response and repositioning. Implying movement, the moving body is linked to spatiality and temporality. There are several roles of the elements that appeal to this lens. Looking at the findings through the moving body perspective, we observe that there are two ways in which the moving body is addressed: on one hand, we have the approach of the instructor, which incises on the moving body of the participants in order to trigger or change muscular changes. The instructor roles that appeal to it are explaining, and correcting.

On the other hand, we have the element practitioners, whom perform the changes in their body. The role that applies to the moving body perspective, from the practitioners’ perspective, is implementation.

The next perspective, the sensing body, relates to the world and how the body senses and experiences it. In the findings, the roles that appeal to this lens are the ones that include the use of artefacts. The artefacts, as part of the physical context of the activity, shape how the sensing body relates to the activity. The way in which the instructor uses the objects (in order to challenge and help the activity), as well as the perceived roles of the objects by the practitioners (amusement, motivation, challenge and help), help to describe the form in which the practitioners relate to the physical context and the activity.

Finally, the last perspective, the relating body, encompasses the social dimension and how bodies relate to each other. The roles that relate to this last lens are the ones that relate to the communication that exists between the instructor and the practitioners, such as the roles of requesting (of both elements), and answering, which appeal to the communication between the two elements.
Moreover, the findings also emphasize the embodied experience of the activity, where the body is the vehicle of interacting with the world, but moreover, it is also a way to get knowledge about it. It is particularly interesting the role of the practitioners of *knowing through their body*, in which their body serves as a mean of knowing about their performance.

In the chapter Background we also present and review various design approaches to movement-based systems. Those design approaches either aim at pulling the activity out of its context in order to recreate it in a different setting, like as Nintendo Wii Boxing or Social Yoga Mats (Maybach et al., 2011); aim at filling a gap in the activity through technology, like Zatoń et al. with their device for swimmers, or Chi et al. with their 'Killer App' for taekwondo assessment aid; or aim to create a technological intervention in the same context where the activity takes place, like Ludvigsen et al. with their TacTowers for handball training.

We are going to review two of these examples according to our findings, Social Yoga Mats and TacTowers, given that the activity to which they relate is social, co-located and instructed. The first one, Social Yoga Mats, serves as an example of an approach that could benefit of the insights of a study as the one we conducted, whereas TacTowers serve as an approach that is in line to the findings of our study.

Maybach et al.’s design is worth reviewing, given that yoga is an activity that shares several traits with Pilates: both are social, co-located and instructed, and some simple artefacts are used. Maybach et al.’s approach is to relocate the performance of the activity, from the class where it takes place to people's home. In order to do so, they propose the creation of the social yoga mats, mats which people have home that are connected to each other in a way that the practitioners of yoga can know when another practitioner, who also has a social yoga mat, has started to practice (see Background for a further description).

With the knowledge about this type of activity gained through our study, we can pose some shortcomings that we observe in such an approach to a co-located, social, instructed activity.

First, their approach disregards the activity of its social context and the importance of the instructors. It takes the practitioners back to their houses, isolated from the natural context of the activity. This kind of approach can be interesting: it allows people to perform the activity at any desired time, as many times as they want, while being at their place. However, this kind of approach can be also disregarding: as it can be observed in our findings, there is a rich communication between the
instructor and the practitioners, in several manners, which can not occur in an approach as Maybach et al.'s: first of all, the role of the instructor of providing cueing, in the form of explanation and feedback, is neglected, which subsequently has an impact on the practitioners themselves (the main focus of the Social Mats). Without the instructor, the practitioners lose the only source of explanation, and thus, we argue that they should have to rely on exercises that they already know, or other types of explanation that they can retrieve from home (i.e. videos, books). Moreover, they lose an important source of feedback. We pose in our findings that the practitioners regard the instructor's comments as one of the ways in which they know about their performance, which is supported by the role of the instructor of providing feedback. Moreover, considering the role implementation of the practitioners, one of the most extensive manners in which they adapt a movement is in basis to the corrections provided by the instructor.

The target group of Social Yoga Mats is elder people, and their aim at facilitating the activity by allowing them to perform it home, while at the same time aiming at a certain connectedness (knowing when the other practitioners are connected), but disregarding the social interaction that exists in the activity.

Besides, Maybach et al.'s initial approach isolates one practitioner from the others. Our findings reveal that practitioners check each other, and copy each other. With both the practitioner and the setting of multiple practitioners, the isolated practitioner loses all forms of appraisal and assessment. And last but not least, leaving the instructor and other practitioners out of reach, without providing a system that is supportive of social interactions, the practitioners lose all the possible channels of communication.

Summarizing, our findings reveal that almost all the roles of both practitioners and instructor revolve around each other: instructing, implementing, providing feedback (both of them), checking... so as to mention the more salient roles. Maybach et al.'s design isolates a practitioner, neglecting not only the social context, but the dynamics of the activity itself. We consider that a review of their approach in basis to the findings we present could result in a more enriching and sensitive approach, without disregarding the ecology present in the activity.

The next example that we are going to review, in basis to our findings, is Ludvigsen et al.'s TacTowers. They present four prototypes of towers for aiding the handball practice, which contain instances of 'balls' that, through sensors and diodes, detect the touch and light up or turn off accordingly. As we posed in the chapter Background, we found this approach interesting, since it
managed to design a non-intrusive intervention to the real setting where the activity takes place: the handball field. Unlike in the previous example, the role of the instructor is not neglected, but included. For the different roles that we identified from the instructor's perspective, the TacTowers do not represent a drawback in any of them, and we argue that they may even help enhance the assessment role of the instructor, given that in their design, the movements of the practitioners result in visual feedback (if they touch a ball, this turns on or off, due to the lights it has embedded), that the instructor could use as an aid of their role of checking.

We argue that the assessment roles of the practitioners' are also supported by the TacTowers, given, once again, the visual feedback they receive while interacting with them. They receive real-time feedback, every time, of their actions. In any case, the dynamics between the instructor and the practitioners should not be disregarded due to the inclusion of the TacTowers. We argue that the assessment role for both parties is supported by the TacTowers, given that they provide visual feedback on whether the practitioners manage to touch the 'balls' or not. Nonetheless, there are other aspects of the performance that are not revealed by the TacTowers, such as the rest of the body movements, their quality, position, etc. In which the instructor can not rely on the technology to know about them, but has to keep assessing the practitioners in the traditional way (checking).

Regarding the rest of the roles of both practitioners and instructor, the TacTowers do not suppose a drawback or limitation, since they relate to the communication channels open in the activity (request and provide).

Summarizing, under the light of our work, we believe that the TacTowers suppose an ecological intervention to the setting where the activity takes place. In basis to our findings, we have seen how it supports some of the roles of the practitioners and instructor, and those who are not supported, are not challenged either by the design. We consider this approach as one that has taken into account the richness of the activity, and has been designed with the goal of supporting the existing activity in the context that it occurs. We think that this design shows a deep knowledge of the activity, with a clear wish of preserving the essence of it in the artifact-mediated version.

We have reviewed so far two approaches: one that disregarded part of the richness that we found to exist in an activity, and another one that supported such richness.
6.3. **INSPIRATIONS FOR DESIGN**

With this section we want to highlight some aspects of our findings that we believe could be relevant for the design of future technological interventions. We advocate for inspiring designs in which the technology supports the activity (is just an element more of the activity), rather than sustaining it (making the activity dependent on the technology) (Waern, 2009), as it is reflected in the aspects that we present next. Nonetheless, the inspirations for design that we present do not constitute the totality of opportunities for design that can be found in the Findings. Here we review some inspirations for design, anchored in those findings that we believe to have a relevant incidence in the activity, and that can be supported through the use of technology.

First of all, we consider relevant the amusing role of the artefacts. The findings point out to the fact that the challenging nature of the artefacts can result in amusement, due to the difficulty of performing with them, and the funny moments that derive from it. This aspect of the role of the artefacts has been argued in other studies, such as Márquez et al.'s, where the difficulty of the artefact can lead to fun: “*(the BodyBug, a mobile device) provided them with an excuse to perform ‘embarrassing’ movements, allowing them to not dance *well*” (Márquez et al., 2013). This feature could be used in future designs that aim at creating a funnier, inclusive experience, as a way of de-embarrass practitioners in the class, making them less concerned about performing poorly by making the ‘poorly performance’ something amusing, allowing for mistakes, or keeping the focus on the exercise, but removing a bit the seriousness of it, for instance, by emitting a funny sound when the artefact is not used properly (i.e. the ball falls, the practitioner missteps on the bosu).

Still regarding artefacts, there are some of them that could anchor new technology. For instance, we believe that digital clothing could be used in artefacts in order to aid the performance. For instance, it could be implemented in the mats, in order to highlight in the exercises which are the areas (that correspond to the body) in which the practitioner should focus, or as a guide to which position to adopt, for example by lighting up specific areas of the mat.

There are other artefacts, such as the balls or rolls, that sometimes are used to ask for pressure on the participants (pressure them with the knees, hands, etc). They could be provided with pressure sensors and a feedback system in order to let the practitioners know if they are inflicting the right amount of pressure.
The next finding that we consider relevant is the use of merged techniques, from the instructor's part, to provide cueing and feedback. As it can be observed in the chapter Findings, there are several uses of merged techniques all along the activity. We considered the use of merged techniques as a way to strive for clarity. Future design interventions centred in aiding the roles of the instructor could take into account this feature (striving for clarity), for instance, adding new ways to the merged ways in which the instructor provides cueing and feedback, or taking over some of these ways, to release the instructor from some of the load, as it has already been done in other fields, such as rehabilitation: López Recio, Márquez Segura, Márquez Segura and Waern (2013) introduce the NAO robot to take over the role of the physiotherapist of modeling the movements the elder person is to perform.

Similarly, design interventions aimed at enhancing the experience of the practitioners could use the existence of merged techniques in order to include supporting features to them. Moreover, as we observed in the chapter Findings, all the ways in which the instructor provides cueing do not trigger an implementation from the practitioners' side, but help to the understanding of the explanation. The technological interventions could be aimed at further supporting such explanation, for instance, a sort of ambient technology, supported by screens or projections, aiming at complementing the instructor’s explanation by displaying images; or soundscapes, for supporting the breathing.

Another aspect to consider is the practitioners as sources of feedback per se, not when they actively answer or request, but through their performance. Future designs could aim at aiding this role, making it easier for the instructor to get feedback about the practitioners' performance, for instance, through wearable devices on the participants that reflect their movements and positions.

The existence of diverse instructing styles, coexisting in the same activity, is also worth mentioning. We argue that the fact that the instructor displays different instructing styles reflects part of the complexity present in the activity. One possible inspiration for design could involve the technology taking over one of these instructing styles, aiming at a technology-supported intervention.

We also consider interesting the characteristic of the explanation, imagery. The idea of creating images and sequences in the practitioners head, linked to clearer allegories of the exercise, could be supported by the inclusion of technology, for instance, through visual or auditory aid, but also appealing to other senses and experiences, such as touch, resulting in a richer experience of the activity.
We believe that a review of the findings from a designers' perspective can unravel several opportunities for design. Apart from the findings we have commented, there are several more that can support, or can be supported, by technology, and with different goals: easing the exercise, increasing the difficulty of the exercises by introducing challenges, aiding or enhancing existing roles, creating richer experiences and atmosphere... Moreover, the findings can be used as a starting point to explore/research/design for new aspects of the activity that are beyond the scope of this study, for instance, knowing which roles an instructor perform, technological interventions could be create to aid the instructor in their training and practice.

In this section the research questions have been posed, along with their answers; the findings have been linked to theory and related work, and finally, some inspirations for future design interventions have been presented.
7. CONCLUSION

In this chapter we will first broadly review our study and reflect about up to which extent we have answered and met our goals. We also present the limitations of the study and the ideas for future work. We follow with considerations about the methodology we employed and ethical issues, and we finish with a broad reflection on our contribution.

7.1. The study

At the beginning of the study we identified certain deficiencies in some movement-based interactive systems, which disregarded the physical and social context. We argued that some of these deficiencies can be overcome by acknowledging in the design not only the technological aspect, but the social and physical context as well. We advocated for looking into an already functional and rich activity in order to get a comprehensive understanding of it and the way the different elements involved in such a type of activity work towards its accomplishment. Therefore, we turned to Pilates, an activity that is co-located, social and instructed, and that can use artefacts or not in its practice, and we identified the elements involved, their roles and characteristics.

At the beginning of the study, in the chapter Introduction, we presented the research questions that we aimed to answer. In basis to the results, in the chapter Findings, we presented our answers to the research questions, along with a review of relevant findings besides the answering of the research questions.

At this point we can argue that we have been able to present a general view of a class of Pilates, and that we have been able to respond the research questions, but always in basis to the results achieved, and taking into account our limitations, which will be presented in the next section, Limitations and future work. The findings of a study like ours is subjected and valid within the scenario in which the data has been gathered. We are aware that in other scenarios, with different settings, the findings may change, as well as future research on a similar scenario can provide new insights. Thus, the representativeness of our study is subjected to the factors above mentioned.
7.2. Limitations and future work

The study presents certain limitations that are necessary to mention. First of all, we would like to pose the limitations present in the study regarding the data gathering.

As it can be read in the chapter The Study, we attended some classes of Pilates in the gym Campus 1477 and organized, along with the instructor of the classes a session with four participants, which we recorded on video. The ideal approach would have been to be able to record one of the 'real' classes we attended, meaning that we would have had a view on the activity as it develops in its real context, with a sample of participants who have chosen to practice Pilates and have attended at least some classes (are not total beginners), and with the instructor acting in the real environment. Several factors prevented us from doing so: the instructor suggested that it would be better for her to conduct a special class for the study, in which she could speak English, and in which she could focus on the people participating in the study, which most likely would not occur in a setting of a real class, where probably some people would not be participating. Another factor was that we encountered difficulties recruiting participants to the study, although we approached them from several angles and with the help of the instructor. This led to having to recruit a convenience sample, consisting of people who attended the same gym and were willing to participate in the study, but had no previous experience with Pilates.

Despite these drawbacks, we managed to record a setting which is also common: classes with smaller groups, and in this case, a total beginners group, and the instructor organized the settings and the class accordingly.

A consideration to be made regarding the questionnaires is that with the questionnaire of the practitioners we managed to reach people who have practiced or practices Pilates frequently, which provides us with context. On the other hand, the level of skills of the people who answered the questionnaire varied from beginners to advanced students, which is reflected in different responses. Nonetheless, given the exploratory nature of the study, as a first attempt to look at Pilates in such a way, we just propose that further work regarding specific levels of skills should be performed. The questionnaire of the instructor provides us details and insights that complement what was observed in the video, but does not allow generalization.

Regarding the method application, there are issues to consider both in the video analysis inspired in Grounded Theory, and the questionnaires, analyzed taking as inspiration Content Analysis. Regarding
the video analysis, we argued in the chapter The Study that we stopped coding once we considered that theoretical sufficiency was achieved. Since in these kind of approaches the researcher shapes the research, as we posed in the chapter Introduction, we contemplate the possibility that others would have not only performed the coding otherwise, but would have considered theoretical sufficiency at another given point. That is why we want to emphasize once again the constructivist nature of our approach, in which the researcher creates the knowledge along with the data, more than being a discoverer of it.

Regarding the results and findings, there are some shortcomings. For instance, the analysis of the video and questionnaires did not provide a deep insight into the role of the artefacts for the instructor, or further understanding on how the instructor uses them, and as previously stated, more insight on the instructor's views (beyond what could be observed in the video) is lacking. Moreover, the results are intrinsically tied to the data gathered in the setting of the recorded class, meaning that in a class with more people or different skill level could result in different results, and thus different findings. Thus, we consider that further research aiming at gathering further understanding of the instructor's views should be conducted, as well as further research regarding different characteristics (number of people, level of skills).

Moreover, although the interaction between practitioners and instructor is profusely depicted, the study did not reveal interaction between the practitioners themselves, which as stated in the introduction chapter, is an important factor for the practitioners of an activity and a motivator, and which had been observed in the attended classes prior to the study. Further research could focus on unveiling this missing interaction.

Finally, the study provides a first exploratory holistic vision of the activity, but more in depth studies regarding specific topics should be performed. In order to gain a deep understanding of different aspects, a study aiming specifically at addressing such aspects should be performed. As possible future areas of research, we suggest to take a deep look into the role of the artefacts in an activity. In our study we point out to roles of the artefacts, but we had data about the basic ones, such as the elastic bands, balls and bosu. Pilates offers a wide range of exercises that are performed with functioning machines. Further research, not only on the artefacts but on the machines, can provide useful knowledge and inspiration for designing technological interventions with this kind of elements. We also suggest, as a possible area of future research, to study in a deeper way the feedback and different channels of information, both of the instructor and the practitioners.
7.3. Methodological discussion

As discussed in the chapter Introduction, we take an interpretative, constructivist standpoint in our research. We have video recorded a class and created questionnaires in order to gather data, and we have been inspired by Grounded Theory method and Content Analysis method to analyze the data. Nonetheless, we are going to discuss how other approaches would have contributed to the study.

We decided to record the class in video because it allowed us to analyze it afterwards. We believe that this approach provided us with insightful data about the class, since it allows the researcher to return to it as many times as necessary, and it provides both images and sound of what is going on (Heath, Hindmarsh & Luff, 2010). Nonetheless, this approach does not allow us to get an insight on people's views on the activity, and in basis to that we created the questionnaires, with most of its questions being open-ended but pointing to what wanted to be answered, aiming to avoid drifting or doubtful answers (Silverman, 2010).

We decided to analyze the data inspired by Grounded Theory method, since it allowed us to develop our research grounded on the data and dependent of it, as well as it allowed to go back and forth from the data (Charmaz, 2013). On the other hand, we decided to analyze the questionnaires with a simplified version of Content Analysis, since it allowed us to identify concepts most represented in the questionnaires, many of which related to the designed questions. In the case of the questionnaire for the instructor, since we had only one sample (see the section Limitations in this chapter), the application of a method inspired in Content Analysis was more challenging, as it reflected in the results (see Results chapter), where the results of such questionnaire where included in the content of the video-analysis, whereas the practitioners' questionnaire responses provided enough data to be able to classify the content into their own themes.

We also argue that other methods of gathering data could have provided other insights. Although not present in the study, while we attended the classes of Pilates we kept a diary record, as a sort of researcher diary, with annotations of the researcher about the experience. Using a research diary was useful to gain insights and be able to design questionnaires that are relevant for what it's being studied, to understand the participants answers in the light of our own experience. Nonetheless, we did not use that data for formal analysis, but rather we opted for focusing on studying an observable phenomena and analyzing related data that would add to it.

We also maintained an informal conversation with the participants of the recorded class after such, which was also recorded and thereafter transcribed, but due to time limitations we could not analyze.
Both research diary and transcription though have the potential to be used in further research on the topic.

Taking field notes during the classes we attended was also considered, which could have provided an insight over time on the practitioners performance. The field notes are less intrusive (could have been performed during a usual class, without the need of placing the cameras and having them during the whole class), and could allow to see the progression, however it was decided to record the class, since we consider that it covers better the gathering of data of the activity.

We would like to finish the discussion on methodology with a few comments on the validity of the study. Golafshani (2003) states that to strive for validity in qualitative research, one of the most accepted strategies is triangulation, in which the study combines methods and data from different sources, even combining qualitative and quantitative data. Golafshani also argues that triangulation is equally important when the researchers take a constructivist standpoint, where multiple sources of data and methods can help unravel the diverse realities of people. Moreover, Golafshani argues that adhering to a open-ended perspective in constructivism, triangulation can imply also including the participants as assistants to the research.

Despite the limitations in our study, we can argue that we have striven for validity by having employed different methods of gathering data and analyzing data, and although not in depth, we also engaged the instructor of the classes we attended in the creation of the questionnaires, which she reviewed and provided feedback upon.

7.4. Ethical considerations

We had to consider some ethical issues in our research. The biggest challenge we faced, regarding ethics, was to approach a real setting and try to perform our study there. We believe that the use of cameras and the fact that we would be recording people discouraged potential participants to the study to not participate. Although we created consent forms in which we presented the study and listed under which conditions we would treat the data (for research purposes only) and which rights they had as participants, such as being able to retrieve from the study, anonymity by being able to request blurring their face, some people who had shown certain interest in answering the questionnaires retrieved altogether from the study when they were asked if they wanted to participate in a recording
class. To those who participated though, the consent form was provided, upon which they agreed to being recorded and their image used for research purposes.

With the questionnaires we faced less challenges. We started the questionnaire providing information about the research, under which conditions we would treat the data (again, for research purposes) and the rights they had as participants, which included the possibility of retrieving from the study, answer only the questions they wanted, and anonymity. Answering the questionnaire was the content form itself. In the practitioners' questionnaire not everybody to whom we provided the questionnaire replied, and some of those who did adhered to their rights and did not answer everything. Regarding the instructors questionnaire, as mentioned earlier, only one instructor replied. In case of further developing of the study, it should be considered if this lack of participation is linked to an ethical issue or to factors unrelated to ethics.

### 7.5. Contribution

The analysis of the results provides a holistic look into an activity like Pilates: working, co-located, social and instructed. The maps (Chapter Results) and the complete set of roles in Findings can be used by designers as inspiration for future design interventions.

Moreover, the findings can also be understood as a tool for analyzing existing systems, as we do in the review of the related work in the chapter Discussion, and as an orientation in order to improve a system.

Finally, the methodological approach of the study, the aim of understanding an activity before designing for it, can inspire future similar studies aiming at gaining an understanding of physical activity.

We hope that this study can contribute, in one way or another, to the creation of systems that do not disregard the physical and social context, and that aim at not being neither limiting nor constraining, but towards a more ecological approach.
Understanding the design space of an instructed physical activity in a co-located, social setting.
8. REFERENCES


Understanding the design space of an instructed physical activity in a col-located, social setting.


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