Sportification: an exploratory study of the executability and generative power of Sportification with children

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Abstract

With lots of research into Gamification and Playful design, a logical next step is to explore a design method that includes Sports. To fill this gap in the tricky triad of game, play, and sport, we propose the concept of Sportification, derived from the concept of Gamification: "the use of design elements characteristic for sport within non-sport contexts". To test the generative power of this proposed framework, it was used in co-design sessions with children. To show the executability, we applied Sportification to an existing interaction through four co-design sessions, and then performed a user test with the resulting Sportified prototype on location. The results of applying this framework showed that children are very adept at working with the proposed framework for Sportification and that adding Sportification to an interaction creates situations and generates ideas, such as whole body movement and coaching, beyond what could be expected from Playful Design and Gamification.

1 Introduction

Sportification builds on the ideas of Gamification and playful design. Gamification uses elements of the definition and the description of what games are and applies these elements to different contexts [1]. Playful design, similarly, uses elements of play to change interactions and has also been researched as such [2, 3]. Since Suits [4] shows the difference in definition between sport, game, and play, this eludes to something called Sportification using elements of sports instead of game and play. From these three concepts and their respective design method, Gamification has been researched most often, and it is very successful for the generation of ideas in Interaction Design and Human-Computer Interaction (IxD/HCI) [1]. Playful design, designing playfully, has also been researched [5] and also shows positive results for idea generation within IxD/HCI [6]. However, what is less researched is the IxD/HCI-related application of interactive elements, from a sports-view instead of a game- or play-view, to a non-sports context [7, 8]. Sportification leverages elements of the pre-established concept of sports within non-sports contexts, like Gamification leverages the elements of games. Since sports and games are different [4] they likely also consist of different core concepts, which Sportification would like to exploit.

Similar to Gamification, we define Sportification as "the use of design elements that are characteristic for sports, within a non-sport context". [1, 7]. This concept of Sportification is already used in reality shows and TV. For example, shows like MasterChef use judges, coaching, and training, which are seemingly sports elements [9]. Similarly, shows like 'The Eurovision Song Contest' also utilize sports elements like judges, teams, and audiences. Within these reality shows a focus is put on the entertainment value of Sportification for an audience. We can extend this value by making Sportification add value for the user as well.

The practice of creating new sports is an alternative definition for Sportification, this is already a more widely known thing for end-users[10]. However, this is not parallel to either Gamification or Playful design as it creates a sport out of something that was not a sport, which goes against the idea of Gamification to "not result in a game" [1]. This shows that there is a gap in knowledge, namely the application of sports elements to make interactions more interesting for users and generate ideas for designers that neither Gamification nor playful design would create.

What this research created, and what did not exist before the start of this research, is a clear definition of Sportification that is usable in IxD/HCI within a relevant non-sport context. Since there are a lot of similarities between the idea of Gamification and the idea of Sportification, in this research we will first draw a parallel to Deterding et al. [11] to then go towards a definition of Sportification. From this definition we will create a set of elements of sport that are applicable to an interaction.

To research the proposed definition of Sportification and some of its postulated elements, we apply it to research that is currently ongoing, in which both I and the main supervisor were already involved. This research is called ACHIEVE, in which children are playfully made aware of healthy and sustainable food choices. The current interaction that ACHIEVE resulted in was an interactive shopping cart. The shopping cart design and general context of ACHIEVE will be elaborated on in section 5. Within this context, we specifically target children; therefore, children are also the target group of the interaction that we want to create through the Sportification co-design sessions; they are also the group we co-design with as "children are experts at being children" [12]. Research on Gamification already showed that it can be a valuable tool for co-design [12, 13] so more specifically the main research question of this thesis is:

"How does the application of a new concept of Sportification in co-design change the emergent interaction with the ACHIEVE cart, differently to Gamification?"

To answer this, we first need to define what Sportification is. Therefore, we will answer the following question: "What is Sportification?"
In the second part of the research, we will try to show the generative power of Sportification by attempting to apply it using co-design in a more general non-interactive setting. This will help us answer the question "What happens when using Sportification in the co-design process with children?"
The third part of this research will aim to answer the sub-question:
"How well can children handle the elements of Sportification?" with this sub-question we want to see if, and to what extent, children can grasp the concept of Sportification. To evaluate this question, we turn to a model of cognitive learning proposed by Bloom Krathwohl [14]. Bloom's taxonomy describes the six levels of cognitive learning, and will be further explained in the next section. Analyzing the performance of the children on each of these levels gives us an

idea of the level at which children can grasp Sportification. Applying this taxonomy, we can more specifically look into to what extent children can remember, understand, apply, analyse, evaluate, and create the elements of Sportification. This thesis is part of the master Interaction Technology. In this context we do not only design a new technology or apply a new design method to design interactive technology, as set out in the previous questions, but also investigate the subsequent interaction. Therefore, the more socially relevant question is: "What happens when implementing the elements of Sportification to an interaction?". The interaction in this specific research is the ACHIEVE project.

Afterwards, we will evaluate how much the Sportification elements compare to those of Gamification. And we will see if the interaction from the co-design differs from what could have been generated through Gamification. This to answer the question: "How does the application of Sportification differ from Gamification?".
The contributions of this research are a clear definition of postulated elements of Sportification with a framework surrounding the elements, along with a proof of concept of the generative power of Sportification in a co-design setting. Furthermore, it includes the results of the first time that Sportification is applied within the field of IxD/HCI showing the usefulness of the proposed Sportification elements.

To answer these questions, first we describe the relevant literature in the related work section. Then, the definition of Sportification will be posed in the Sportification section. Afterward, the context for the interaction will be explained in the ACHIEVE section. In the following co-design section we use the definition and the context for the design of a co-design session and the results of its execution, during which an interaction will be co-designed with children. In the supermarket section, the interaction will be adapted and tested inside of a supermarket. Finally, the results will be presented, and analysed. Then the results will be discussed in the discussion and conclusion sections.

2 Related work

2.1 Sportification

We first focus on the term 'sportification'. Batuev and Robinson [10] have described how an activity that was not yet a sport, can be turned into a sport via inclusion in the Olympic games. Which is an interesting fact but, as Gamification does not try to create games, we are not trying to create a sport. Heere [15] describes how activities like e-sports were 'sportified' by "adding a sport component to an existing activity in order to make it more attractive to its audiences". This definition is very close to this research's idea of Sportification. 'sportification' as Carlsson and Svensson [9] describes a concept that is closer to what this research tries to show; how modern concepts like MasterChef have been 'sportified'. While both Carlsson and Svensson [9] and Heere [15] make great steps in the exploration of 'sportification', they leave room for the use of the Sportification phenomenon for applications within interaction design. They pointed us to inspiring examples of 'sportified' interactions like MasterChef and e-sports, from which inspiration for the elements of Sportification can be drawn. Furthermore, they are a great starting point of a more structured overview of elements of sport that can be used in Sportification.

2.2 (Co-)design with children

The context to which we apply Sportification to, is focused on children. A user group for which co-design is seen as a good research method [16].

Dodero et al. [13],although focused on educational functions, show how children can spontaneously produce Gamification elements. So there might be merit in trying to have children produce the elements of Sportification. Furthermore, they show children applied Gamification successfully, an indication that children might be able to do the same for Sportification.

A lot of studies have children as co-designers [17, 18, 19]. One of the lessons from the studies is the notion that the use of video in co-inquiry will lead children to perform when they know a camera is present. However, if the camera is hidden you will lose out on valuable angles since the movement of children is quite unpredictable [19].

Other lessons in the form of guidelines for working with children is given by Fails et al. [12]. They describe the several roles that children can play in the design process, see Figure 1 and this is backed up by Guha et al. [20]. Within this research the children will play the role both of tester, by testing the finished application, and design partner, by helping us create an application. In previous research within the ACHIEVE project they also took the role of informant, meaning they informed us about the things they would like to see in the supermarket. Fails et al. [12] proposed many different methods for design, the methods we choose will be discussed in the design of the various co-design sessions of this research. In addition Sanders and Stappers [21] describe the co-design philosophy that should be striven for as Leading, providing scaffolding,

and provide a clean slate.

To provide the scaffolding in the co-design sessions for this research we made a deck of cards. Fradinho Duarte de Oliveira and Petersen [22] describe the creation of a similar deck of cards containing Gamification elements that aid in design, and analyses its success. While this research has been done with adults, its success suggest that these cards, when made simpler, can aid in remembering and applying the parts of Sportification for children as well.

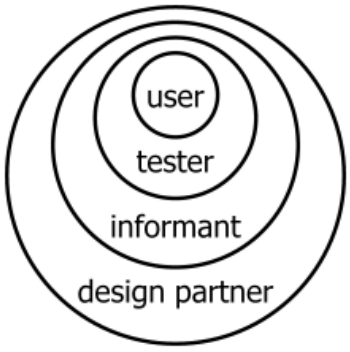

Figure 1: The different roles children can play in design (from Fails et al. [12])

2.3 Bloom's Taxonomy

To give an indication of and measure learning during the co-design and the resulting interaction we turn to Bloom's Taxonomy [14] which describes the six levels of cognitive learning. These levels create a ladder of complexity and specificity, Figure 2. With the elements remembering, understanding, and applying, analysing, evaluating, and creating being sequentially ordered in difficulty and building upon each other. This ladder is used to show the level's of grasping a concept. When considering these elements from the other side, you can see that when people show the levels of Bloom's taxonomy, they show that they grasp, to an extent, the elements of Sportification. Within the revision of Bloom's [14] intended learning outcomes are phrased as "[...] (a) some subject matter content and (b) a description of what is to be done with or to that content." This can be used to phrase intended learning outcomes and then compare if children have reached the intended learning outcome. Furthermore, the taxonomy can be used to describe what someone who has mastered the concept would show and can be compared with current behaviour to see if the observed children are at that level.

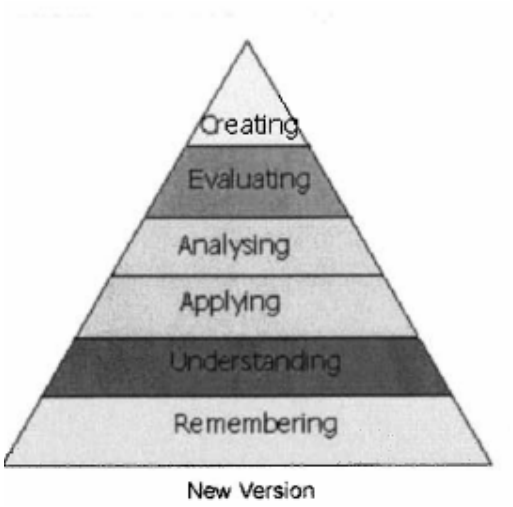

Figure 2: The different elements of Bloom's taxonomy [23]

3 Sportification

Within this current research, multiple iterations were taken to obtain the core definition of what Sportification is. There are, in essence, two distinct iterations of the concept of Sportification. The first iteration, as described in the preparatory research for this thesis [7] in which the first draft for the elements of Sportification was postulated using both a bottom-up approach. For the top-down approach, we looked at elements that were present in several definitions of the word sport, as well as several elements that repeated themselves within different sports.
In a second iteration, a broader subdivision was made to correct the level of abstraction of some of the elements, this was done to create a fair layering as well as more closely resemble the idea of Gamification.
A last iteration was done through user studies in the research where we noticed the phrasing of the elements did not fit the specific context or where feedback from other researchers or the participants resulted in the alteration of some of the elements. The discussion will outline how the changes for this last 'iteration' came to be and the implications beyond the scope of this research.

3.1 First Iteration

3.1.1 From definition to elements

To find the elements that are part of Sportification we first look from the perspective of definitions. For this we look at four randomly chosen well-known definitions of sports and see what elements repeat. The definition of sports changes from source to source:

According to the Olympic committee, a sport is: "All events sanctioned by an international sport federation" [24]. Now this definition does not bring us closer to what in essence a sport is, though it does show that organization is an important part of sports. Some more useful definitions towards this goal are:

- The Oxford dictionary defines sports as: "An activity involving physical exertion and skill, esp. (particularly in modern use) one regulated by set rules or customs in which an individual or team competes against another or others." [25]
- The Council of Europe defines sports as: "All forms of physical activity which, through casual or organized participation, aimed at expressing or improving physical fitness and mental well-being, forming social relationships, or obtaining results in competition at all levels." [26]
- Lastly, Oxford Learner's Dictionary defines sport as: "Activity that you do for pleasure and that need physical effort or skill, usually done in a special area and according to fixed rules." [27]

All these definitions of sport share the elements of "physical activity" and "rules". Physical activity is a nuanced term here as intense physical activity could lead to physical exertion as well. This will lead to this term changing to "Exertion" in future versions of this definition. Furthermore, some definitions, while not backed up by all definitions, do contain elements that we propose are important to sports; these elements have been inspired as well by televised competitions, as described by Carlsson and Svensson [9]. The elements that are proposed in this first iteration of Sportification to define sports are as follows:

Regulation
A sport has a set of rules, regulated by a non-biased third party.

Competition
There are many ways to structure a sports competition; the goal of these competitions is to, at that moment in time, determine the performance of the players or teams.

Improvement
An important factor within sports is improvement. Coaching and training are tools for players and teams to improve.

Team spirit
Team spirit is the connectedness of the team. This can be shown in many ways but one of the main ones within sport is team apparel. It is shown that group cohesion is directly linked to the team's motivation [28]. Evans et al. [29] showed that team spirit even improves the performance in individual sports. Lastly, it is shown that spectators also gain psychological benefits from feeling connected to a team [30].

Expressiveness
Within certain sports the player can express themselves [31].

Physical exertion
Sports generally require some degree of physical skill and exertion.

The following are not derived from the definitions but are derived from existing work on Sportification [9] which recognises these elements in already existing applications, similar to what happened in defining gamification [1].

Audience

At sports events often an audience is present. It's shown that both audience and players benefit from audiences in sports [30]. A more nuanced view is that, while own supporters can increase player performance, hostile supporters for others can decrease the performance [32].

Media coverage

For most sport events there is some sort of media coverage, be it local, national, or global. Very major sporting events even get cast live.

3.2 Second Iteration

Upon reviewing this first iteration of Sportification, some of the definitions, naming, and categorization of the elements were changed for a short paper [7].

The product of this iteration can be found at Figure 3. To arrive at this product, firstly, some of the elements were higher level concepts, henceforth called categories, that were misguidedly labeled as elements. This caused them to be less implementable than their element counterparts. To rectify this, some elements were moved to a higher level, becoming a category. Furthermore, some new elements were made to cover subjects that were not previously covered. Secondly, Regulations was not implementable thus, it became a category including the elements: *rules*, *referee*, and *penalties*. Competition was also moved to being a category with the elements: *teams*, *judges*, and *leagues*. Improvement was re-contextualized to Skillfulness as improvement is an (implied) result of the elements not an element on itself. Skillfulness, however, is still not implementable and thus was made a category containing: *training*, *coaching*, and *quantified self*. Both Expressiveness and Exertion were moved under the new category of Physicality, along with the new element Whole body movement. Lastly, *audience* and *media coverage* were categorized into Performances, along with the new element *showmanship*.

Table 1 shows the old elements of Sportification. Figure 3 shows the current proposed elements of Sportification, the categories they are divided in, as well as the translation that has been used for the research with Dutch-speaking children.

3.3 Comparison to Gamification

To evaluate the space that Sportification holds we can look at the similairity of elements between Sportification and Gamification.

Some of the elements of Sportification are also found directly in Gamification. This is the case for Rules, Penalties, Leagues and Teams. Rules are inherent to

Table 1: The old elements of Sportification

Design element	**Implementation**
Regulation	Rules, judges, jury
Competition	Points, leaderboards
Improvement	Coaching, training, analysis
Team spirit	Apparel, shared training
Expressiveness	Freedom of expression
Audience	Supporters
Media coverage	News articles, live casting
Physical exertion	Physical exercise

Games. Penalties build upon these rules, if you make a mistake in a Gamified experience you might lose resources (e.g. turns, leaderboard positions). Leagues are a different way of implementing leaderboards so also exist in Gamification. Lastly, teams are present in many games, but specifically in Gamification as well look for example at the Duolingo "friend quests" where your progress is also dependent on a friend.

When looking one step further, more of the Sportification elements can be linked to Gamification. When rules exist, someone (or something) needs to enforce these rules, this leads to the existence of a Referee. When points, badges, or experience exist these give a way to measure your performance, this is a direct example of Quantified self. Training here can be seen as practicing which is part of any experience that you can repeat.

When going even further away, we can see the different types of gamers [33] and what they like to do in games. When looking at the free thinker we see "(they) are motivated by autonomy, meaning freedom to express themselves.." which leads to the element of Expression. "Socialisers are motivated by relatedness. They want to interact with others and create social connections." these players would enjoy a system of Media coverage, along with the Achievers who can show off their achievements.

The remaining elements of Sportification cannot be easily linked to Gamification but they could be derived from specific patterns around gaming. For example Showmanship and Audience fit to the streaming of a game. And games in which the game includes movement like Just Dance Now [34] add Exertion and Skilled movement to the experience.

This then leaves a Jury and Coaching as elements that are unique to Sportification.

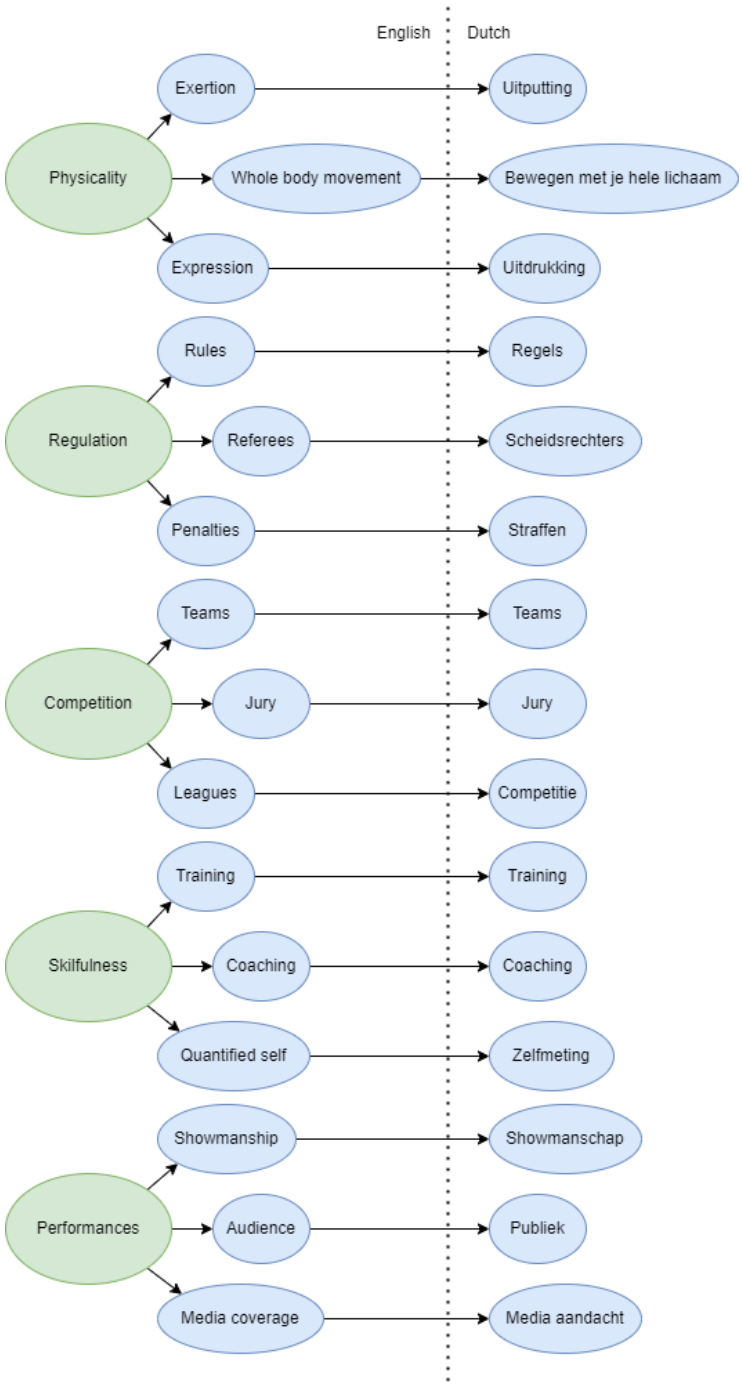

Figure 3: The elements, categories, and translations of Sportification

4 ACHIEVE

The basic interaction on which we will apply Sportification is the ACHIEVE context. This is the context of an interactive supermarket shopping cart for children through which healthy and sustainable food choices are encouraged. The research was started as a collaboration between University of Twente with Jumbo Leussink, LTO Noord, and Mineral valley. Research into this shopping cart has been done together with us for the past three years. To make the shopping cart interactive a tablet was added to the cart. In Figure 4 we provide an overview of the interaction we used as the basis for this research, and below we describe each of the steps in more detail.

1. When children use the shopping cart, they first will choose from several healthy recipes on the tablet, they then need to find a section of the supermarket (e.g. fruits & vegetables, meat, dairy, or bread).

2. When arriving at a section, they will need to hold an RFID card from a placed poster to the reader of the cart.

3. After this, the children will be prompted with questions about sustainability for a selection of the products from this section that are in the recipe. The questions are multiple choice questions (three options) with the correct answer being a product that is in the recipe. The correct answer needs to be tapped on the screen. When selecting a wrong answer the answer will be removed from the options and the children will be asked the question again.

4. They are then also asked to bring these products along so that they can make the recipe at home with their parents.

An animated mouse (Figure 5) will guide the interaction by asking the questions out loud as well as by indicating when the children should go to a different section. As part of this ongoing research, the interaction was tested in a supermarket by me and one of the supervisors. This test showed positive responses by the children.[1] This was observed in children laughing or calling out *'yessss!'* during the interaction and a child wanting to go again immediately.

The creation of this shopping cart was also co-designed where we were involved. Children of a daycare were asked what they would like the interaction to be like and to give feedback on the several iterative designs of the researchers. Throughout the design of the shopping cart, several sessions for feedback like this were held. This research continues in this context by adding the element of Sportification to it.

[1] https://www.tubantia.nl/hof-van-twente/scheuren-met-interactieve-winkelwagentjes-in-goor-feest-als-dit-karretje-er-is a28eda28/

Figure 4: The interaction of ACHIEVE inside of the supermarket

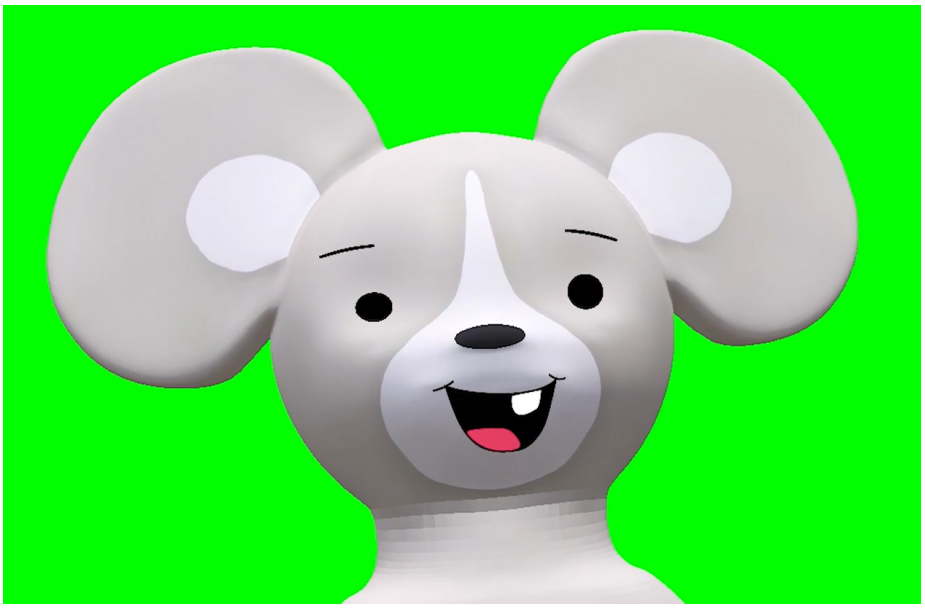

Figure 5: The ACHIEVE mouse (art by Julia Valeria Lopez)

5 Co-design

5.1 Method

For the co-design a daycare was approached. The daycare asked the parents whether their children wanted to participate in this research. For a total of 19 children consent was given. A varying selection of children participated in each session, based on their presence at the daycare. The co-design was designed using methods from Fails et al. [12] and adapted to fit the supermarket interaction environment. The age range of the interaction, 7-11, overlaps with the age range of the co-design that Fails proposes. As Fails et al. [12] state, the design process will be "Define the problem", "Research the problem", "Create solutions", "Evaluate solutions", and "Reflect on outcomes". Within this process we will involve the children in the second, third, fourth, and fifth step as the problem definition is already covered due to the design being applied to an already existing interaction. In the first phase of the design the children will receive the definition of the problem and together we will research it. In phase two we will try to create solutions for the problem. Evaluation of solutions is done with different children than those who design, these will also reflect on the outcomes as they will be testing the interaction in the supermarket. Based on the scope of the research as well as the phases of the design process we decided to have four co-design sessions with two main design goals:

- **Teaching Sportification**
  The goal of the first part of the research was to familiarize the children with Sportification. During this we wanted to observe how well the children did in the Remember, Understand, Apply, Analyse and Create parts of Bloom's taxonomy. The evaluating part was not used. For this an observation script was made, this script can be seen in Appendix A. This goal was achieved using session 1 and session 2. This goal coincides with the "Research problem" step of the design process.

- **Contextual design**
  For the second part of the research the goal was to add, using co-design, the elements of Sportification to the existing interaction of the interactive shopping cart, during this we observed how well the Children did on the Apply, Analyse, and Evaluate parts of Bloom's taxonomy. This goal was achieved using session 3 and session 4. This goal coincides with the "Create solutions", and "Evaluate solutions" step of the design process. Throughout the sessions we will go through these steps multiple times.

To ensure good research ethics in the four sessions, an ethics request was placed at the University of Twente, approved under RP 220071. At the daycare a consent form was distributed and the children of whom the parents gave consent were included in the co-design.

5.1.1 Session 1: Introduction to Sportification

As Fails et al. [12] tells us "it is important to adequately contextualize the system via an introduction so that children are prepared to perform their design work with the proper context in mind". This is the scope of sessions 1 and 2. In preparation for the first session, a deck of cards was created featuring the elements of Sportification that we distilled in Section 3.2, this deck of cards can be seen in Figure 6.
Session one started with an open discussion about sports, to gain insight into what children already knew but also to gauge if they could already name certain elements of sport, as this would signal that they have a good understanding of what makes a sport. If they can think about the elements that make up a sport this indicates that they, to some extent, can come up with elements of Sportification.
After this, there was a demo on what Sportification is, for this a simple non-sport context was taken (stacking blocks) and all elements of Sportification were added while showing their respective cards.
Once the children were introduced to the concept and were familiar with the cards, snippets from television programs were watched that were Sportified and therefore included the elements of Sportification. Carlsson and Svensson [9] proposed MasterChef as a stereotypical use of Sportification, 'Heel Holland bakt' is a similar show in Dutch in the Netherlands. The children were then asked to hold up the cards when they thought they saw an element. These were then discussed.
In this session we planned to see how well children can Create and Understand the elements of Sportification.

5.1.2 Session 2: Practicing Sportification

In the second session, the children tried to apply Sportification to another simple non-sport context. To do this they had to think of ways to apply the several elements of Sportification to this context, which was drawing. The context for this session was determined together with employees of the daycare to find a context that the children were interested in as well as a context that motivated the children. This context was not to be a sport, nor was it to be an already Sportified activity. The Sportification was aided by the designed cards as the session was not an exercise in remembering, though if the children did seem to remember certain cards this would signal Bloom's Remembering part. Furthermore, the Sportification was to be aided by a discussion with the researcher during the interaction about certain elements or concepts.
In this session we aim to see how well children can Apply, Understand, and Analyse the elements of Sportification.

5.1.3 Session 3 and 4: Sportifying ACHIEVE

In the third and fourth sessions, the children tried to apply Sportification to the shopping cart context. This was done in a co-design session with the researcher.

Figure 6: The cards containing the elements of Sportification

The children were let free in their ideation using the cards since the sessions should still not have solely been an exercise in memory, and we tried to steer the ideation in the correct direction. The reason that steering by the researcher was needed is that the children thought of ideas that were unfeasible or dangerous when left completely free. A careful balance had to be struck as we did not want to impair the creativity of the children or make them feel like they could not come up with certain ideas, while still ending up with an interaction that is safe and practical.
In this session, we evaluated how well children can Apply, Analyse, Create, and Evaluate the elements of Sportification.

5.2 Results co-design

5.2.1 Session 1: What is a sport?

In session 1, 6 children participated all between the ages of 6 and 8. 3 of which were female, and 3 of which were male.
The first part of session 1 gauged what the children thought to be elements of sports. The children gave different answers, but the consensus was that it entailed movement of some sort, also described as "getting thinner". Furthermore, they named that there should be a winner (*competition*) and there should be *rules*. Lastly, they decided that you should get tired from sports (*exhaustion*).

5.2.2 Session 1: Stacking blocks; first Sportification.

For the second part of session 1, we tried to add the named elements to stacking blocks and we also tried to introduce the other cards with ideas the children named. Starting from the *rules* they decided that stacking blocks would be fun while running from one table to the next stacking a block and then tagging in a teammate (*teams*). Furthermore, the children said that someone had to enforce the *rules* "Like the referee in football, with red and yellow cards!" (*referee*, *punishment*). After handing out team apparel, a whistle, and a red and a yellow card, and playing a round of stacking blocks and having a winner, the concept of *training* was introduced by asking them how they would get better, this also sparked talk about *quantified self* and *coaching*. Lastly, they decided that the researcher was like an *audience* member, clapping and cheering for the players.
Apart from the cards *judges*, *showmanship*, *expression*, and *media coverage* this means they managed to name or describe all the other cards, only needing minimal guidance from the researcher e.g. by asking them what card would describe a specific thing they named ("We practised!", "What is another word for that?").
These last concepts were introduced by creating a new game in which the goal is not to stack the blocks as fast as possible but to stack the blocks in the prettiest way (*expression*), along with acting the best while moving in between the tables (*showmanship*). To rate this they needed a person who was not part of either team (*'judge'*) who got cards numbered 1 through 5 and made a call on the final score of each team. This match was concluded by saying that it could be on television and therefore would also be good for *media coverage*.
The difference between the cards *showmanship* and *expression* seemed quite hard to grasp for the children. After a short explanation and some examples, it seemed like they understood, but during the rest of the session it seemed like they were still a little confused since they kept using them sparsely and interchangeably. In the next session we will aim to make the difference clearer.

5.2.3 Session 1: "Heel Holland bakt"

In the last part of session 1, the children were shown fragments of the Dutch baking show "Heel Holland bakt". Each fragment dealt with one (or multiple) parts of Sportification. The children were asked to pick up the card(s) that the fragment was about. Apart from the main mistake that "happiness means expression" the children seemed quite capable of determining all the cards. A few difficult ones were:

- *quantified self*: since this was quite different in baking (tasting, timing the cooking, temperature) than in sports (timing the performance)
- *showmanship*: this seemed a difficult concept for the children to grasp as it was misunderstood on multiple (three) occasions where they randomly picked it during a fragment that did not contain any *showmanship*. Even after an explanation of the concept of *showmanship* the misunderstanding remained.

5.2.4 Session 2: Practicing Sportification

In session 2, 11 children participated of which 6 participated last time and 5 were new. They were aged 6 to 8 and 5 of them were female, 6 of them were male.
The first part of the session was a short recap of the previous session. This was needed because the 5 new children that joined needed to also be familiarized with the concept. During the introduction for the new children, it was quite difficult to keep the attention of the half that already knew what we did last session.

5.2.5 Session 2: How do we apply Sportification?

In the second part of the session, Sportification was applied to the act of drawing. Based on the observations during session 2 there seemed to be roughly 4 distinct categories: Easy cards, slightly harder cards, hard cards, and unused cards.
Easy cards
As part of the session the children were asked to apply Sportification to the interaction of drawing. The first things the children applied were the *rules*, they then quickly went on to add a *judge*, a *referee* and an *audience* as they remembered having those roles last time. They then also immediately named *punishment* as this was part of the *referee* task. When asked what the roles of the *judges* and *referee* were in this specific setting, they had to think a little. Suggesting they understood some of the elements that needed to be added but not that they needed to be fitted to the interaction. This same thing happened when they were asked to add different *rules* to drawing. This is also when they realized they had to add *teams*. *competition* was named with as an example winning, but when discussing the number of *teams*, they decided it would be a

tree-diagram like *competition*, which is way closer to the envisioned definition of a *competition*.

Slightly harder cards
The cards 'movement', *exhaustion*, and 'media attention' were named quite early in the discussion but the children did have some trouble putting them in to the interaction. It took them a while to think of a way to add movement and exhaustion to drawing without just aimlessly jumping up and down. The immediate answer to *media coverage* was to put it on television but that was not an option in the setting, so they eventually came up with a newspaper that did work in the setting.

Difficult cards
A few of the cards that the children forgot to name were *expression* and *showmanship*. Once named they were worked into the interaction, but the children had trouble coming up with them themselves.

Unused cards
The cards, *training*, *coaching*, and *quantified self* were, even when named, too difficult for the children to add. They did seem to grasp what the cards entailed but they did not manage to place them in the interaction. This could very well be because they all seem more like things to do outside of the interaction.

5.2.6 Session 2: The eventual interaction

The eventual interaction that the children came up with was a match in which two *teams* of two competed against each other. The *referee* would give them an object or concept they would need to draw. Then the first team would designate a drawer who would draw on a piece of paper on the back of their teammate. This all had to be done while running circles around a table. When finished or when the *referee* decided that the time was finished, they would need to stop drawing and the *judges* would score them. Three *judges* scored the final drawing while one judge judged the way in which they drew and ran circles. When the second team had done the same the team with the most points would have won and advanced to the next round. The referee meanwhile paid attention that the *teams* were running and not walking otherwise they would get negative points. While this was going on an *audience*, of one member, was cheering them on. There was also supposed to be a reporter for the newspaper, but this role was forgotten. As this now comes close to a sport we need to wonder if we did not create one. In the discussion this topic is tackled in more depth.

5.2.7 Session 2: Rating

After playing a few rounds the children were asked if the interaction was more fun than drawing. The reactions to this were quite mixed ("I thought it was

boring", "I liked the running"). They were also asked how the interaction could be improved "It should be 'more fun'", to which the child was adamant that sports should be fun so that should be a card. At this point the session formally ended which meant the children were quite disorganized and not required to listen to us anymore. After the session had ended the children were observed to continue playing the interaction we designed. On a next occasion the supervisor of the day-care informed us that the children were playing the Sportified game for the rest of that day and taught other's how to play, and even that the game was still played some weeks after the session.

5.2.8 Session 3: Introduction to ACHIEVE

In session 3, 8 children participated of which 5 participated before and and 3 were new. They were aged 6 to 8 and 4 of them were female, 4 of them were male.
At the start of the session the children had to be familiarized with the shopping cart. For this a little introduction was done in which the first section of the interaction was performed. This means the children had to take the shopping cart to the 'vegetable section' a smaller version of the sign normally present in the supermarket and a card to scan were present here. They had to scan the card and then they had to answer questions about the fruits and vegetables needed for the recipes. Based on the observed laughter and energy expressed, the children seemed to enjoy the interaction with the shopping cart very much.

5.2.9 Session 3: Sportifying ACHIEVE; part 1

During the session the first discussion that was started was about what *rules* to use for the interaction. After many ideas were suggested, this discussion eventually resulted in a consensus that the general *rules* of conduct in a supermarket should be followed. Along with the rule that you should not disturb the other team. Thereafter, they decided that to implement *exhaustion*, that the *teams* had to race. To add some *punishment*s, if the *rules* were not followed, they thought of having to start over. Then there was the idea of *teams*, the children decided that they should be in *teams* of two people. Interestingly, the amount of team members was always two whenever the children created *teams*. By doing a small polonaise they incorporated *skilled movement*. *Judges* were instantiated to judge how people walked, although *expression* was not explicitly stated. Furthermore, a *referee* was appointed to keep to the *rules* and the time. Lastly the *referee* needed to make sure that all participants understood the interaction.

5.2.10 Session 3: The new interaction

The eventual interaction at the end of session 3 was one were the children competed 2v2 where each team had a shopping cart. They then had to race to the section sign after which they had to run back to the starting line. At the end the *judges* would give them a grade for running. A *referee* was also present

to make sure the *rules* were enforced. Furthermore, one of the children wanted to be the grocery sign, which is quite a remarkable thought as the grocery sign is an immovable object that we had not imagined could be personified. This is an interesting concept which we elaborated on in the next session.

5.2.11 Session 4: Sportifying ACHIEVE; Part 2

In session 4, 10 children participated of which 5 participated last time and 5 were new. They were aged 6 to 8 and 5 of them were female, 5 of them were male.
After familiarizing the new children with the concept of the shopping cart, the concept of Sportification, as well as with the ideas of the previous session. The co-design started again. As someone suggested they wanted to be a grocery sign this time we suggested we tried asynchronous *teams*. One team had the *skilled movement* of running while finding the grocery sign at the next section, while the other team was in charge of hiding this sign. Here they decided on a new *punishment* of added time when *rules* were broken. To add *training* and *coaching* they decided on an app that helps you practice the hiding of sections at home so you can become better at the interaction while not in the supermarket. *Quantified self* was understood as time, so they took this as making the interaction timed and having a limited time to complete the interaction.

6 Supermarket

Based on the co-design sessions there is now a first version of the interaction. However, it had to be adapted to the supermarket environment, as there were ideas that the children had that would not work in a supermarket. Within interaction design it is common practice to adapt the ideas of a design session to fit the environment in which the interaction will be placed, this can for example be seen in Fox et al. [35]. The design goals of this session were twofold, we wanted to see what happens when Sportification is applied to an interaction, and we wanted to see how well children can Analyse and Evaluate an interaction that was Sportified.

6.1 Design changes

Firstly, having multiple (many) children in one place is not an option for the supermarket as the chance that multiple children enter at the same time is quite small. This same reason also causes the need for the *teams* to be asynchronous. Lastly, since people are not likely to go to their supermarket at appointed times, a *competition* using rounds is quite hard to implement. This is solved by creating a *competition* in which times are averaged, this way children can 'compete' asynchronously at their own time. Several of the elements (*expression*, *judges*, *training*, *audience*, *coaching*, *showmanship*, and *media coverage*) have not been implemented as they were not implementable within reasonable flexibility to the system designed by the children. These elements were covered in the other Sportification exercises during the co-design sessions. Since these elements where not properly added to the interaction that means that less conclusions can be drawn concerning them.

6.2 Method

To see what happens when adding Sportification to an interaction we observed the interaction using an observation script: Appendix B. To see how well they could Analyse and Evaluate the elements of Sportification, we performed a card sort using the cards of Sportification, which can be found in Figure 6. For the card sort the children were shown 5 cards after the interaction and they were asked whether or not they felt that a card was part of the interaction. 5 cards is 1/3 of the total cards, this was picked as a balance between boring the children, keeping overview, and getting enough information. A thing of note here again is that some of the elements were not part of the interaction. Furthermore, they will be asked what, if anything, they would change about the interaction to assess how they liked it and to inspire future improvement.

6.3 Results supermarket

6.3.1 Design

The design for the supermarket was an adaptation of the initial design of ACHIEVE explained in section 4. The adapted design used in the supermarket can be seen in Figure 7. The children run along a yellow line in the supermarket until they reach a question destination (A), they then scan a bar code on the question and get a question on the screen (B), after, they scan the product (C). If the correct product is scanned the mouse on the screen will congratulate them and ask them to go to the next question. If it is wrong, they will get a time penalty of 5 seconds which is shown in red text on the screen. After which they will be asked to try again. At the end of the interaction an ending screen is shown, see Figure 8. At this end screen, the children will see their own time as well as the average time of their team. To simulate the *teams* there are two carts with different coloured shirts on them side by side, Figure 9. Furthermore, throughout the entire interaction, we were walking with them to answer questions (only sparingly) or point out if they were severely deviating from the interaction.

Figure 7: The interaction that was present in the supermarket (A) shows a recognizable pillar in the supermarket (B) shows the question on the screen and (C) shows scanning the barcode on a product to answer the question

6.3.2 Participants

Within the supermarket we had 22 participants between the ages of 5 and 11. (14 male, 8 female). These participants ranged over 3 8-hour days of having the interaction in the supermarket. To recruit participants we were standing in the supermarket and asking parents whether their children, that looked like they were in the target age range of 7-11, wanted to participate and "race a shopping cart through the supermarket." If the parents and the children agreed, the parents were asked for consent, conform the approved ethics request under RP 220071.

Figure 8: The end screen of the interaction

6.3.3 Observations

The general observations for the interaction in the supermarket were that the children were enjoying themselves, showing in laughter or smiles along with excited chatter. The children also seemed motivated to perform the interaction. Several children did not feel the need to hurry, even though it was specifically mentioned that they could run in the supermarket and that they were timed. Furthermore, a lot of children missed parts of the interaction like the line they were supposed to follow, the spots in the supermarket at which questions were supposed to be asked by the cart, or the products they were supposed to take with them, resulting in a chaotic interaction. With some guidance (e.g. "You are not following the line", "Try scanning it again", or "Did you remember to bring the product?") all the children managed to complete the interaction. For detailed observations, see Appendix C.

6.3.4 Card sort

During the card sort only five cards were shown per child. When analysing the card sort performed by the children in the supermarket, see figure 10 we can see that from all cards used in the card sort, some were never picked as being part of the interaction while some were picked almost every time. Based on the card sort, we can separate the elements of Sportification into five categories:

Figure 9: The shopping carts with the different coloured shirts on them at the entrance of the supermarket

Elements that were present that were picked a majority of the time
In this category we have: *exhaustion*(5/5), *skilled movement*(7/8), *rules*(4/4), and *quantified self*(4/4).
exhaustion was almost always described as "being exhausted from running". Interestingly the *skilled movement*, specifically describing movement that requires skill, was always attributed to the same parts of the interaction as *exhaustion*. One set of participants did show that they thought more about *skilled movement* as one person ran ahead to already answer the questions, this showed a great deal of insight on how to move skillfully during the interaction. *Rules*, though picked often, was less obvious to the children then the data may show. First, some children got small hints from their parents before deciding it was part of the interaction. Furthermore, one child attributed *rules* to "the cart deciding what you ate". While this indeed is a thing set by the interaction, it is only a very small part of the *rules* portion implemented. *Quantified self* is an outlier in this research as all the times it was shown it was chosen. Further attention will be given to this in the discussion, but all children that picked this card based it on the fact that there was a stopwatch in the image.

Elements that were present that were picked a minority of the time
In this category we have: *teams*(3/9), *punishment*(0/5), *referee*(0/6), and *competition*(4/10).
For *teams* some children mentioned that they "were alone" while some other

children seemed to not notice, or forget, that there were two, differently coloured, carts present at the start of the interaction. *Punishment* was picked zero times. The two reasons for this were that either the child performing the interaction made zero mistakes(which happened twice, one of which got to pick *punishment*), thus not getting punished, or that the child performing the interaction did not recognize that they were being punished for giving wrong answers. *Referee* was also picked 0 times with one child saying "there is no referee, it is more of a coach" but this statement being directed at the researcher not the cart. *Competition* was picked a few times with a child mentioning "There are two teams, so it is a competition", but adversely to this other children mentioned "It was for fun so not a competition".

Elements that were not present that were picked a majority of the time

There were no elements in this category.

Elements that were not present that were picked a minority of the time

In this category we have *expression*(0/5), *judges*(0/2), *media coverage*(0/2), *training*(3/7), and *showmanship*(1/4).

expression, *judges* and *media coverage* were not picked at all, without much more explanation than 'I did not see it'. This makes sense as it is very hard to explain why something is not present. *Training* was picked three times but was more of a feeling, when asked to elaborate the children could not think of anything. This did not bring them off their opinion that *training* was still part of the interaction. *Showmanship* was only recognized by one child stating: "If you were just the best", referencing to showing off.

Elements with a split in picks

This category consists of the cards that are picked exactly 50% of the time. These are *audience*(1/2), and *coaching*(2/4).

The element *audience* was only shown twice, however the two opinions were opposite, while one child did not feel like there was an *audience* at all, another ascribed this role to his friend who was doing the interaction with him. *Coaching* had a similar split as two children did not feel coached at all while two others ascribed the role to their friend and the researcher.

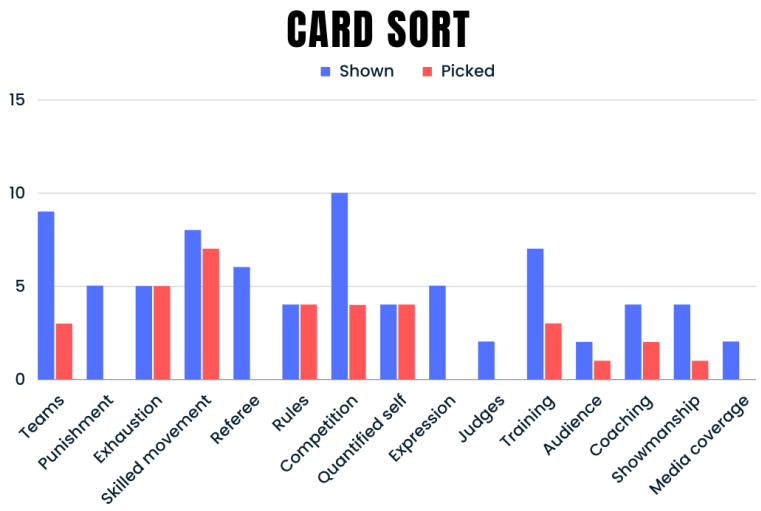

Figure 10: The number of times each element was shown during the card sort versus how often they were picked. The elements from *quantified self* to the right were not part of the final design)

7 Analysis of results

During this research we focused on the research question "What happens to an interaction for children when we apply Sportification to it using co-design?". To this end, we first defined Sportification as with Gamification [1] we distilled elements of sports that might be applicable to non-sport contexts [7]: physicality (*exhaustion*, *skilled movement*, and *expression*); regulation (*rules*, *referee*, and *penalties*); competition (*teams*, *jury*, and *competition*); skillfulness (*training*, *coaching*, and *quantified self*); and performances (*showmanship*, *audience*, *media coverage*). Next, we looked at the extent children would be able to learn Sportification elements. To this end, four co-design sessions took place in a daycare centre. This showed the ability of children to come up with ideas under the constraints of Sportification, as well as showing their understanding of Sportification. The proposed design by the children needed some final tweaks to be embedded in the real-world setting. In the final tests, we saw how children managed to see and experience the elements of Sportification and what it did to an interaction.

7.1 What happens when you use Sportification as a co-design method with children?

When co-designing with Sportification it shows that children have a lot of ideas. Specifically, Sportification ideas, like running around while drawing, were generated that would be unlikely to have stemmed from a co-design with Gamification or Playification. The several sessions all resulted in children enthusiastically talking about ways to implement elements. This resulted in quite the stream of ideas, some more applicable than others. Although some elements were more difficult to grasp than others, it did lead to idea generation and applicable elements.

7.2 According to Bloom's taxonomy to what level can children handle the elements of Sportification?

When looking at the question 'According to Bloom's taxonomy to what level can children handle the elements of Sportification?' we see that at the first three levels (Remembering, Understanding, and Applying) the children could handle themselves well apart from some of the more abstract elements (*quantified self*, *expression*, and *showmanship*), for these elements it seems that they are too complicated for children to grasp, at least with the current scaffolding. In the three parallel higher levels however, we see that creating the simple elements themselves is even possible, and they can handle analysing from an inquisitive standpoint but that is as far as they get, so the levels of analysing, evaluating, and creating for the more complicated elements are limited or not attained. Below we discuss our findings in comparison to each level of Bloom's taxonomy in more detail.

7.2.1 Remembering

When considering the co-design sessions most of the elements of Sportification were only recalled when we actively reminded them by for example, the cards, which might be caused by the fact the children know they can fall back on these. There were, however, two exceptions: it seemed like children are very adept at remembering elements in which they played an active role. For example, the card *referee* was immediately recalled as some of the children *remembered* having that role in the previous session. On the other hand, some of the elements were not remembered as they were either too difficult (*quantified self*) or they were linked to another concept, *expression* as a result of having *judges*. To then answer: "To what extent can children remember the elements of Sportification?" it shows that they can remember almost all of them, but depending on previous interaction with the elements they were able to remember some more quickly, without any additional reminders.

7.2.2 Understanding

For the *understanding* of the cards, there are two cases.
First of all, there is the observations from the daycare, these show that there were three out of the fifteen cards that were not understood by the children; These being: *quantified self* (which was seen as timing), *expression* (which was seen as happiness), and *showmanship* (which was confused with *expression*). Even after explanation, these concepts did not seem to be fully grasped since asking them to re-iterate what these elements were did not bring coherent results.
Secondly, there is the card sort in the supermarket, these show that, once more, *quantified self* was confused with just meaning timing. Furthermore, concepts like *coaching* and *training* weren't clear to all the participants, perhaps due to the context and implementation, and unlike the co-design session, there was no explanation to make them understand. Lastly, *showmanship* and *expression*, while being understood as not in the interaction, were not always understood as a concept. To answer, "To what extent can children understand the elements of Sportification?" it shows that while most elements are very well understood, some of the more difficult concepts need explanation and can even remain difficult when explained.

7.2.3 Applying

When looking once more to the daycare session two it can be seen that elements had four separate levels of difficulty to apply. The first one is the elements that were instantly remembered and immediately sparked an idea for implementation. This section consists of:

- *rules*, applied as the rules for drawing.
- *judges*, applied as a judge that gives score for style.
- *referee*, applied as a referee that looks for rule-breaking and hands out *punishment*s.
- *audience*, applied as someone watching and cheering
- *punishment*, applied as a red or yellow card and having to start over.
- *teams*, applied as two players per team.
- *competition*, applied first as 'someone wins' but later as a tree *competition* when the card showing an image of a tree *competition* was shown.

The second set is that of the cards that were remembered and recalled quite early on but then were harder to find an implementation for, these are:

- *skilled movement*, which was applied as running while drawing.
- *exhaustion*, which was applied as running as fast as you can while drawing.

- *media coverage*, which was applied as a newspaper.

It might be that they were slightly harder to implement as they were also further removed from the idea of drawing as this is normally something to do when standing still. This can be seen in the fact that in the case of the supermarket interaction, skilled movement and exhaustion were quickly picked up as running fast.
The third set is that of the cards that were forgotten but implemented when recalled, these are

- *expression*, applied as the final drawing
- *showmanship*, applied as walking fancily

The reason that these might have been forgotten is that they seem like an automatic inclusion in the term *judges* as the children, when being *judges*, judge style and therefore *expression* and *showmanship*.
Lastly, there is the set of cards that were not implemented even when reminded of, these are:

- *training*
- *coaching*
- *quantified self*

For the elements *training* and *coaching* we speculate that they are too far detached from the interaction happening at that moment, as they require to be given at a different time, that they do not spark ideas for application. Furthermore, as one of the children mentioned, some children might not have had coaches or trainers in their life. *Quantified self* seems to be a concept that is too hard to grasp for children of that age, which means they also do not manage to apply it.

When we look at sessions three and four the first set with immediate ideas consists of:

- *rules*, applied as the rules for the interaction.
- *teams*, applied as two *teams* of two. One hiding team, one searching team.
- *exhaustion*, applied as running with the cart.
- *punishment*, applied as a time penalty when breaking the *rules*.
- *skilled movement*, applied as having to find what is hidden fast.
- *judges*, applied as judging the style of the *teams*.
- *referee*, applied as timekeeper as well as the person giving out *punishment*s.

The second set, remembered after some contemplation, for this session consists of:

- *training*, applied as an app at home.
- *coaching*, applied as an app at home.

The reason that this time *training* and *coaching* were implemented is likely because they were already using a tablet, making the concepts easier to remember as they now had a physical object to link the concepts with.
The third set is that of the cards that were forgotten but implemented when recalled, these are

- *expression*, applied as how nicely children walked with the cart.
- *showmanship*, applied as how fancily they search for it.

Once again, these elements were implied but not necessarily given until asked about them.
Lastly, there is the set of cards that were not implemented even when reminded of, these are:

- *quantified self*
- *media coverage*
- *competition*

Noteworthy is the addition of *competition* in this list as this seemed easy to apply in the previous session. Perhaps the difference here lies in the fact that stacking blocks was immediately decided to become competitive where in drawing the children tried to add it later.
When looking at the lists and comparing them we see that depending on the context different elements are harder or easier to apply. In general, however, the children developed ideas for most elements no matter the context. So, to answer, "To what extent can children apply the elements of Sportification?": we see it depends on the context, while children still came up with implementations of all the Elements of Sportification it still shows that there are difficulties.

7.2.4 Analysing

For this, we look at the card sort (see Figure 10). From these, we can see that some of the elements are harder to analyse than others. Here there are four distinct cases:

- **the elements that were implemented that were recognized**
  exhaustion, *skilled movement*, and *rules*
- **the elements that were implemented that were not recognized**
  teams, *punishment*, *referee*, and *competition*

- **the elements that were not implemented that were recognized**
  quantified self and *coaching*
- **the elements that were not implemented that were not recognized**
  expression, *judges*, *training*, *audience*, *coaching*, *showmanship*, and *media coverage*

When calculating the accuracy of children on this we get around 49 percent, which is slightly lower than random guessing. When, however, observing the fact that the element *quantified self* was seen as timing, as also mentioned in future work. And timing, could be argued, was in the interaction. When accounting for this the accuracy goes up to 54.55 percent. The children however, though not seeming very accurate, did show that they were analysing the elements of Sportification and creating reasons for themselves why certain elements were or were not in the interaction. So, to answer, "To what extent can children analyse the elements of Sportification?" it seems they can analyse, though not very accurately, the elements of Sportification. Another reason for the low score is that we did a bad job of implementing some of the elements, while this is an assumption that can be made only follow-up studies can give a concluding answer on this.

7.2.5 Evaluating

Throughout the design sessions, children had the option to evaluate the elements of Sportification. What this mostly resulted in was confusion about elements. So to answer "To what extent can children evaluate the elements of Sportification?" it seems they can barely evaluate the elements other than to voice their confusion. While this does show that they think of the elements it does not show a good level of evaluation.

7.2.6 Creating

When looking back at session one at the daycare, the question 'What is a sport?' was asked. Here the children, though not asked to explicitly, produced some of the elements of Sportification. They named *(skilled) movement* and *exhaustion* and they described a *competition* and *rules*. Though this is only four out of the fifteen elements it stands to reason that they can at least create some of the elements of Sportification. So, to what extent can children create the elements of Sportification? It shows that they reach some of the simpler, obvious elements but are not able to realise that some more abstract concepts exist.

7.3 What happens when implementing the elements of Sportification to an interaction?

Many interesting things happened when we implemented the elements of Sportification into an interaction in the supermarket case. However, some elements also failed to get a response.

Adding *teams* to the interaction did not seem to have an effect. Children would not wear the provided shirts, though they did notice them or specifically asked about them, they did not feel inclined to wear them even when asked if they wanted to, this problem is probably tied to the design of the interaction where it was not made enticing enough to wear the shirts. Furthermore, while improving their team's time was something they did notice, they did not seem to be performing better because they were competing against another team. We suspect that this is because there is no active *competition* going on. This means that at no point are two *teams* performing the interaction simultaneously, this might lead to the children not seeing the interaction as a proper *competition* against another team. The choice of team was also always based on the colour that the child liked better, none of them showed that they picked a choice because of the time on the screen. Either making the time and therefore the competitive element, bigger or more obvious or creating a situation in which two *teams* do face the interaction in parallel, might make for a more engaging interaction.
Skilled movement showed to be a very interesting element to add, other than in Sportification's counterparts Gamification [11] where points or badges are the main driving force of motivation [1], it seemed like children enjoyed performing the movement present in the interaction, regardless of points. Some children seemed to really be running fast even though they did not notice their time at the end of the interaction. This means that while in Gamification the interaction is performed because of the promise of points or rewards, within Sportification the movement in the interaction is itself a reward. Reiss [36] shows the intrinsic motivations that people feel for "initiating and performing voluntary behaviour". While many different researchers have different ideas about these motivations, two general points seem to be in glory (points) and pleasurable activities (running). Running in this case seems to have bridged the divide between glory and pleasure due to both getting points and performing a pleasurable activity.
The fact that some children missed the time, did not mean that it was unwise to make the interaction timed as this did seem to motivate some of the children very much to run faster. For this, it should be noted that the number of children that visited that felt no pressure whatsoever from the interaction would still be experiencing all the other parts of Sportification, just not the "*exhaustion*" one. This shows to some level also the flexibility within the design where children can choose to pay attention to the elements they enjoy or that motivate them, while ignoring some of the others.

8 Discussion

8.1 Success of the co-design

In the co-design we can see that children managed to come up with ideas for each of the elements when helped. When looking at the ideas generated they work well for a different setting than then one in the supermarket. This indicates that the co-design, while successful for the eventual design, was quite unsuccessful in having the children come up with ideas on their own. Co-design, however, is co-operative and with the help of the researcher the children could come up with ideas for all the elements of Sportification.

8.2 The concept of Sportification

One big question of this research is whether or not we created sports by applying Sportification. By the definition of Sportification: "using design elements characteristic for sport in a non-sport context" we do not aim to create a sport. When looking at the example of the drawing game created in the co-design session, we got quite close to creating an actual sport. The thing that could be said though is that, through adding the elements of sport we approached a sport, much like skateboarding did before it became a proper sport. Whether we think that we created a sport or not, Sportification led to idea generation and an interaction that was, according to some of the children, better than the regular one.

8.3 Difference to Gamification

To see if Sportification has it's own area within the design space we have to see if the ideas generated from Sportification could also be generated when using Gamification. For this we look at the final expressions of Sportification in the interaction as can be seen in appendix D.

When evaluating if these expressions could have stemmed from Gamification we see that having an automatic referee that enforces rules works like a game and therefore would also be generated if Gamification was applied instead of Sportification. As already mentioned in chapter 3.3, teams and competition as concepts link directly to Gamification and therefore so do their expressions. Making the interaction a timed interaction is the same as the 'timed constraints' example in Gamification [1]. In these 'time constraints' we can also see that time penalties could easily be generated from Gamification.
Running with the cart while scanning products is an expression of Sportification that we believe would not stem from Gamification as it is not a standard "Game element" to run.

when looking slightly earlier in the process to the suggestions the children came up with then we see "Walk in a fancy way" and "Judge the fancy walks" as

ideas that came up. These ideas seem like they would not have stemmed from Gamification as they take a more subjective approach to a competition which Gamification does not seem to have. While "Use an (practice) app at home" seems to be at the core of Gamification and a "Newspaper" would stem from Gamification as e.g. the periodic publishing of a leaderboard. "People come to watch" seems to not stem from Gamification at all, as already mentioned in 3.3 this is something specific to Sportification.

8.4 The design process and philosophy

One of the children raised the interesting point that an interaction we designed was "for fun so not a competition". This leads to an interesting question about the definition of some of the elements. As with this sentence, the child shows that our definition for *competition* does not align with theirs and therefore they cannot recognize it. What this shows is that however strict we pose definitions for elements it is still up to the interpretation of the user.
An interesting development in the addition of elements of Sportification is the question of what decides whether an element is part of an interaction or not. For the interaction in the supermarket, not all elements were actively incorporated in the design of the interaction. However, some of the elements, like *training* and *coaching*, were often picked as present in the interaction even though they were not added in there by design. Most children who picked these elements attributed it to the fact that the researcher, guiding the interaction, felt like a coach or a trainer. Then, even though the elements of *coaching* and *training* were not added to the interaction directly, they do become part of the interaction. This shows that even though elements might not be set out to be present they do become present by the people experiencing the interaction saying they are.
This same concept also applies to the addition of a *referee*, while in the interaction design the cart was appointed as a *referee*, keeping the time and adding time when a question was answered incorrectly, the cart was never given this role of *referee*. Whenever a child said they recognized a *referee* in the interaction this role was ascribed to the researcher. An interesting question here is if this is because the children did not ascribe agency to the tablet or if the concept of *referee* strictly needs to be a human in their eyes. Since a literature search did not come up with anything conclusive about this it might be interesting to look further into this phenomenon.

8.5 The use of cards

When looking at the success that Fradinho Duarte de Oliveira and Petersen [22] had with their design cards, our cards measured up quite differently. This was for one reason: the Gamification cards were used for adults instead of children, this meant they could be much more verbose. When looking at the lack of understanding of the Sportification cards, more explanation to a more mature audience might have led to better results or at the very least more

understanding. Given the attention span of the children we still believe that having the cards as is was beneficial to the co-design as you could see the children use them as reminders of what the elements were. Unfortunately, Fradinho Duarte de Oliveira and Petersen [22] did not use pictures so they did not have the same problems with imagery and translation as we did.

8.6 The supermarket environment

There were some shortcomings when considering the supermarket environment. These were caused by three key characteristics of the supermarket that made it different from the daycare. First of all, the supermarket (unlike a daycare) is bound to have more rules regarding disturbance. While in a daycare children can be loud and energetic, in a supermarket this might be too disturbing for the customers. Secondly, in the supermarket most of the time there won't be multiple children present. This means that while in the daycare the interaction could be done competitively against an opponent that is there, in the supermarket we had to make sure that children could compete on their own. Lastly, since children do not always visit the supermarket when their parents do, they might not join for visits systematically, or their parents might not visit systematically, it is quite difficult to implement elements like *training*, *coaching*, and *competition*, as these could require regular attendance to planned events. While creativity in the elements of Sportification can solve several of these problems, it does limit the options for implementation.
Some of the parents of the children had decided to actively participate with their children, while this made sense for the children who could not yet read, it was also an occurrence with the children who could. When struggling the parents would help them by giving them hints or guiding them to the correct answer. While this is, presumably, done with good intentions it does change the outlook on the data slightly, as the opinion of the children might sometimes have been steered slightly by their parents. For the context of ACHIEVE, however, this is also an expected use of the shopping cart. If parents are shopping with their children they might want to participate with the interaction as well.

8.7 Future work

There are several other recommendations for future work which we would like to share.

An interesting thing during the co-design sessions was the difference between imagery against text. When presented with the cards several children decided that they meant a certain thing because of the images, even when the text described a completely different concept. This concept is especially clear when looking at the *quantified self* card which depicts a stopwatch and was without fail described as being "a timed experience". The difference between the interpretation of pictures and text and the apparent disconnect there could help facilitate future co-design with children and therefore is interesting to research.

When applying Sportification to another interaction it would also be useful to do a full card sort. Within the supermarket concept unfortunately we could not manage to do a full card sort as we quickly lost the interest of the children. Making a more interesting card sort and with it doing a more expanded card sort should prove to give more insight into what children can recognize within a Sportified interaction and should give a better overview of the opinions of the children.

When doing co-design with children it is tricky to place the boundaries in such a way that they are not limited in their creativity while still providing useful input. While research into this is already abundant. Fails et al. [12] mentions that this problem could be resolved by taking the children into the environment that is to be designed. Adding this to a new investigation in Sportification should show how some of the elements that were hard to implement in this research can be valuable in different contexts.

While designing the deck of cards specifically for Dutch children, a translation had to be made. This translation, while trying to be as accurate as possible, was sometimes noted to be slightly flawed or at least disputable. An example is *expression* which can be translated both to the Dutch 'Expressie' and 'Uitdrukking' the latter having been chosen for this research. Unfortunately, during this research, only one word was used but it stands to reason that using the other word might have changed results or understanding. Apart from trying to see what words work best to describe the concepts while keeping as broad of a concept as possible, it should also be interesting to try out different words with children to see which ones they understand best and which ones are most confusing, this to aid future researchers in their choice of words. Another example is tree- or bracket-based *competition*, while the currently used word is *competition* another word like league or division might be clearer or encompass the idea of the element better. We wholeheartedly recommend for other researchers to see how the elements of Sportification could be named and translated for a more precise definition.

During the sessions, it seemed like applying some elements such as *judges* and *media coverage* were more difficult depending on the context, e.g. drawing. It would be interesting to see whether this is specifically true for children, or if this holds for multiple age groups. Furthermore, when analysing whether some elements are always difficult for a certain age group, or difficult for all age groups it could show points of improvement in the posed framework of Sportification, or the need for more training in applying Sportification correctly. Researchers could then use specific alterations for specific age groups or change the framework altogether to be better applicable.

Once the definition for Sportification is more widely explored and refined, a good exercise would be to apply it on other IxD/HMI interactions as well as in

parallels to Gamification. In the literature, for example, Gamified Co-Design [37] is a well explored concept. A 'Sportified' co-design, then, is interesting to explore the concept of Sportification and its link to Gamification even further. For this, an element like showmanship can be included with a presentation about the co-designed results. Having this presentation judged can then be an implementation of the jury element.

Lastly, a point of improvement of the research would be to conduct the research in a different, freer, context. Due to the supermarket context some of the timed, periodical, elements like training, *coaching*, or *competition* were almost impossible to implement traditionally. Using a more frequently repeating context like lunch breaks or playing outside there could be better insight into the implementation of these specific elements that did not loan themselves to a supermarket environment.

9 Conclusion

While exploring the question "How does the application of a new concept of Sportification in co-design change the emergent interaction with the ACHIEVE cart, differently to Gamification?" it shows that the ACHIEVE interaction, when adapted with the co-designed Sportification elements, was received positively. This shows that there is potential for future interaction design and future research to utilize Sportification. We successfully defined Sportification as "the use of design elements characteristic for sport within non-sport contexts". The framework for Sportification following from this thesis project can be used by children given enough help. However, some, such as *quantified self*, *expression*, and *showmanship* are harder to learn successfully. To use it as a co-design method though, steps need to be taken. First of all, you need to display the information in a way that the children can understand and you need to make sure to give them all the necessary help to use the design method. When this is done, however, it can be seen that a lot of insight into how children experience sports and sports elements can be gained from having children use Sportification during co-design. Furthermore, even though many of the elements are similar to Gamification, adding Sportification to an interaction created some situations that showcase they would not be linked easily through Gamification. As we trialled two situations quickly and analysed and recognised many more, it seems interactions can benefit from Sportification both inside and outside of the IxD/HCI field and hopefully, it will be picked up as a design tool in the future.

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A Observation script for the daycare

A.1 Session 1

During session one, notes will be made about the interaction that children have with the elements of Sportification.
This entails:

- They mention specific concepts that belong to Sportification
- They imply an understanding of a certain concept of Sportification.
- They show difficulty in understanding a certain concept of Sportification.
- They show that they remember elements of Sportification.
- They show that they understand at a larger level the concept of Sportification.
- They show that they can analyse the elements of Sportification.
- They evaluate the elements of Sportification.

A.2 Session 2

Along with the observations for session one, additionally, there should be attention paid to:

- They show that they can apply the elements of Sportification.
- They show that they have difficulty applying the elements of Sportification.

A.3 Session 3 and 4

Along with the observations for the first two sessions, additionally, there should be paid attention to:

- They show that they remember elements of Sportification
- They show that they can create using the elements of Sportification.

Then we will see how
Furthermore during all sessions notes will be made about the interaction designed by the children as the implementation of the elements in the interaction will be used for the eventual design.

B Observation script and questions for the supermarket test

B.1 Observation script

Do the sports elements come to light?

Teams:

- I see them actively pick a colour.
- I hear them say things about their team.
- I see them compare times.

Competition

- I hear them talk about winning and losing.

Exhaustion

- I see them be exhausted.
- I hear them talk about their energy.

Rules

- I hear them repeat the rules.
- I see them stick to the rules.

Skilled movement

- I see them put a lot of energy into moving.
- I see them plan for their movement.

Punishment

- I hear them observe that they get punished.
- I see them actively avoiding punishment.

Referee

- I see them ascribe a deciding role to the tablet.
- I hear them talk about the role of the tablet.
- I see them notice the timekeeping of the tablet.

B.2 Questions

What did you do?
What actions did you take?
Which of the following 5 cards were part of what you just did? Why (not)?

C Observations and answers supermarket

These three participants were one family experiencing the interaction one after another.

Boy 7 difficulty reading
Missed the questions twice.
Didn't take the items twice.
Was not in a hurry.
Couldn't fully read so needed help from mom.
Girl 9 Read the time on the cart.
Ran very fast.
Forgot to take items 4 times.
"Wholewheat bread is healthier."
"Ketchup!!!" lot of energy in the sentence
Final sprint
Told me she "raced through the store".
"Scan healthy products instead of unhealthy ones."
"I lowered the time!"
Recognized the teams and competition cards. Was not exhausted but her brother stated he was.
Very adamant that it "Really felt like a competition, due to the time and the racing".
Quantified self was recognized as the timed element.
Boy 5 Very enthusiastically running.
Knew the answers so he did not listen or try to answer the questions.

Boy 10
Ran very fast.
Missed the question.
Forgot to take the products twice.
Was listening very critically to the questions.
What did you do? "Racing!"
I ran very fast and answered questions.
It was fun because you are allowed to run through the store.
Would be nice if you could scan real products.
This boy was accompanied by a friend, and he therefore ascribed this friend the role of trainer, coach, and audience. Recognized the rules after little nudging from the mother. Showmanship was not part of the interaction.
Said "Exhausted!" afterwards.
Boy 8
Did the interaction together with an actively participating mother.
Did not run.
Missed the questions.
Forgot to take the first product.
Said he "Looked for products and answered questions" failing to see the speed

element.
Would like there to be real products.
Recognized quantified self as there being a timer. Recognized teams: "There were two teams".
Did not recognize competition and expression as being part of the interaction.

Girls 6 & 7

Participated together.
Weren't racing.
Were not in a hurry whatsoever.
Questions were slightly too difficult for them.
Forgot to take products.
Did not see that they were getting punished for a wrong answer.
Told me they "Followed lines on the ground and answered questions".
Did not recognize referee, teams (even though they were together), competition, or punishment.
Recognized skilled movement a little but did not really treat the interaction like a sport so they performed very little movement.

Boy 10

Missed the start, the yellow line, and the question.
Kept up a reasonable pace.
Forgot to take items twice.
Shirt was in the way yet was not inclined to change anything about it.
Was fast.
Considered himself "Pretty fast" after seeing his time.
Told me they "went past everything and answered questions".
Saw that the team-time had improved.
Saw skilled movement.
Didn't see teams as they "were alone".
Was no referee more of a coach (referring to the researcher, not the cart).
Was not a competition as it was "for fun".
Saw no penalties as he made no mistakes.

Boy 11

"Really feel like racing."
Scanned the start a lot.
Missed the questions twice.
Told me he "bolted through the store which is normally not allowed".
Would've liked to see the cart be a racecar.
Did not recognize judges, expression, or punishment.
Did not recognize teams as they "were alone".
Skilled movement: he had to "Run for his life".
Afterwards said "Hup" in a very exhausted manner.

Boy 6 can read

"I would like to be green."
Missed the answer, yellow line, and forgot to take a product three times.
Mother elaborated on some questions.
Told me they had to "collect everything".

“Would more often do groceries if it was like this.”
Did not recognize Competition, teams, or referee.
Skilled movement because you needed to “Run fast”.
Exhaustion “because if you run you get exhausted”.
“The shirt can go” “Why did you not wear it?” “No idea”.

Boy 6

Could not find the start.
Was not in a hurry.
“The time is very high; I can do that faster.”
Forgot to take products 5 times.
Missed a question.
“Look at the time I had.”
“I want to go again!”
Told me he “shopped with questions”.
Would like to have a real register.
Recognized Exhaustion a little bit.
Did not recognize media coverage, training, coaching, or audience.

Boy 10 & 7

Participated together.
Missed the start.
Were very fast.
Forgot products twice.
“Run!!”
Final sprint.
Wanted to have a cart each.
Told me they “Ran and scanned and did a final sprint”.
Would like to have actual products.
They felt coached (again by the researcher, not the cart).
They did not recognize competition, training, or referee.
Skilled movement: “Yes, we ran.”

Boy 9

Shy.
“How does this work?”
Missed the scanning and the yellow line.
Started picking up speed later in the interaction.
Did a final sprint.
Told me they “Scanned product and had to see where the next one was”.
Would like the inclusion of unhealthy foods.
Rules as far as “the cart decided what you ate”.
Did not recognize teams remarked that it could be added if 1 team takes one cart and the other the other one.
Did not recognize Showmanship or media coverage.
Recognized quantified self as being a timer.

Girl 5 (+Mom)

Missed the start.
Felt too young for the interaction.

Mom answered the questions.
Followed the line neatly.
Only recognized that there was a question element after 3 products.
Forgot products.
Weren't running.
Told me she "Walked and ran, scanned product, and put groceries in the cart".
Did not recognize teams, expression or punishment.
Recognized Skilled movement and exhaustion: "tired".
"Why is the shirt attached?" "Do you want to wear it?" "No!'

Boy 11

Was fast!
Scanned everything.
Missed the yellow line.
"Vroom vroom".
"Did I make it?"
Told me they "had to select the healthiest choice, answer questions".
Saw Quantified self as the times were present.
Training "everything was there".
Did not know what a referee was, after explanation did not see it in the interaction.
"Feels like a competition because of the racing."
Had showmanship "If you were just the best".

Girl 10

"Sounds fun!"
Missed the start.
Forgot to take products.
Was very fast.
The shirt was in the way at some point, but she did not pay any attention to it otherwise.
Missed the question.
"Can I go again?" before even finishing.
"Yes 4:02!"
Told me she had to "Run around with questions about what is healthier".
"It's fun to run."
Skilled movement because of running.
Expression was a guess; she could not tell why she picked it.
Felt a 'Match mood' for the competition.
Training and Showmanship were not recognized.

Boys 8 & 6

Participated together.
Missed the start, yellow line, and first question.
"Run!!!"
"We have to run to the register!"
Final sprint.
"We ran around and answered questions."
They would like to add a skateboard or scooter.

They felt like Training was part of it.
They thought both rules and skilled movement were both obvious.
“Running around is not a competition”.
They did not recognize expression.

Girl 10

Missed the start.
Forgot to take products.
Was walking.
Missed a question.
Told me she had to “Follow the yellow line in as short a time as possible”.
Saw that teams were “green here and orange for the other one”.
Competition: “Two teams so competition”.
Exhausted by the running.
Did not recognized judges or punishment.

Girls 9 & 9

Participated one after the other.
Missed the start, did not understand the question system.
Tired because of a birthday party.
One of them ran ahead, showing thinking about skilled movement.
Mother was cheering them on.
They did sprints in between products.
“We raced, did groceries and raced.”
Did not recognize training or referee.
Mother recognized rules.
The other girl wanted a turn.
Picked the other colour.
Ran very fast.
When she forgot the products, the friend helped.
Lots of teamwork
Laughing with the final sprint.
“I was faster!”
First girl wanted to “also take another turn”.

D Card sort supermarket

Table 2: the elements of the card sort, their implementation and the times they were shown and picked.

Elements of Sportification	**Children's suggestions**	**Implementation**	**Shown**	**Picked**
Teams	Pushing the cart together against another team with a different colour	Having two separate colours to play for	9	3
Punishment	Time penalty	Extra time on answering a question wrong	5	0
Exhaustion	Running fast	Timed interaction	5	5
Skilled movement	Running with the cart while looking for sections	Running with the cart while scanning products	8	7
Referee	Looks for mistakes, keeps track of time	Using the cart to check mistakes and keep track of time	6	0
Rules	Behave, do not interfere with others	Stick to the supermarket rules, answer questions correctly	4	4
Competition	Fastest team wins and goes on to the next round	Have an average time for each team	10	4
Quantified self	Timing	Timed interaction	4	4
Expression	Walk in a fancy way	-	5	0
Judges	Judge the fancy walks	-	2	0
Training	Use an app at home	-	7	3
Audience	People come to watch	-	2	1
Coaching	Use an app at home	-	4	2
Showmanship	Walk in a fancy way	-	4	1
media coverage	Newspaper	-	2	0