

'DataBlokken': Stimulating Critical Data Literacy of Children Through the Use of a Life-size Data Physicalisation Game

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Figure 1: Example of the DataBlokken game being played by three participants. One participant just took their turn by rolling the dice as the others watch.

ABSTRACT

Modern data protection regulations place strict obligations on entities who wish to process data from children who are under thirteen years old. However, materials and activities aimed at educating children and young people about privacy and data protection mostly focus on children who are thirteen or older. As social media usage by children under the age of thirteen increases, there is a need to develop education curricula, materials and activities aimed at increasing children's data literacy and educating children about the challenges around privacy and data protection. We present DataBlokken, a life-size data physicalisation game that guides participants between the ages of nine and twelve through a series of challenges that gauge their understanding of data concepts and stimulates their sense of critical data literacy. By playing DataBlokken, participants learn that sharing personal data is unavoidable when navigating a social media application, personal data has value, and personal data ownership is possible. We tested and evaluated DataBlokken with 21 participants playing a total of six games. Preliminary findings indicate that participants enjoy playing the game, understand the rules of the game well and appreciate the size, tangible components and DIY-look and feel of the game. DataBlokken contributes to ongoing educational efforts around the topic of critical data literacy by demonstrating the didactic potential of data physicalisation games in stimulating children's sense of critical data literacy.

Index Terms: Human-centered computing—Visualization—Visualization systems and tools

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1 INTRODUCTION

Against the backdrop of increased social media usage among children [5], a 2019 report by the Royal Society in the UK [8] has highlighted the need to stimulate data literacy. There is therefore a need to develop education curricula, materials and activities aimed at building children's data literacy and educating them about the challenges around privacy and data protection. Accordingly, efforts aimed at educating children in the primary school setting have been welcomed and continue to be explored [15]. When reviewing existing educational materials around data literacy for children, however, there is a notable lack of educational resources designed for children under the age of thirteen, and that these resources are mostly designed to be consumed online or on paper [9, 13, 16]. Research has highlighted the potential of physical learning materials to educate children about complex topics [4]. This work builds on knowledge from the field of data physicalisation to explore the potential of data physicalisation games to stimulate the critical data literacy of children and to activate their sense of agency over the processing of their personal data. We present DataBlokken, a life-size data physicalisation game, that guides up to four participants through challenges that mirror decisions they may make on social media applications. The objective of the game is not to teach participants what constitutes a “good” or “bad” decision, but rather to activate their sense of agency when confronted with choices regarding the processing of their personal data. As such, the learning objectives of the game are threefold. Participants learn that:

- sharing personal data is unavoidable when navigating a social media application
- personal data has value
- personal data ownership is possible

Stimulating children's sense of critical data literacy. This research draws from recent literature on the topic of data literacy by taking a Freirean-inspired approach to literacy that does not just

encompass the acquisition of technical skills, but also the emancipation achieved through the literacy process [1, 7, 11]. Tygel and Kirsch [11] have defined critical data literacy as “the set of abilities which allows one to use and produce data in a critical way,” abilities that include data reading, data processing, data communication, and data production. We will use the term critical data literacy to refer to the process of empowering learners to convey and achieve critical skills that are needed to navigate and act on questions related to the processing of personal data that they may face in a digital environment.

The didactic potential of playful data physicalisation. Research on the role of play in teaching data literacy points out how incorporating play(fulness) can contribute to the promotion of (creative) data literacy [13]. The potential of manipulable physical representations to facilitate learning and understanding has been highlighted [4, 6], and the use of data physicalisation for pedagogical purposes has been shown through projects that aim to convey learning objectives related to teaching visualisation concepts [2, 14], principles of data representations [2, 3], and data interpretation [12]. This study seeks to contribute to research that explores the didactic potential of data physicalisation, through the design and testing of DataBlokken, a data physicalisation game that aims to facilitate critical data literacy learning.

2 DATABLOKKEN

DataBlokken is a life-size representation of a social media application that participants use to socialise with friends. Personal data are represented as large LEGO blocks and referred to as data blocks (DataBlokken), which also gives the game its name. The game has a competitive and reflective element to it and the participants’ objectives are twofold: 1) they have to reach the end of the game board as quickly as possible, while at the same time 2) they have to retain as many data blocks as possible. We designed DataBlokken primarily to be played by children between the ages of nine and twelve and can be played by two to four participants at the same time. It ends when the first player reaches the final square of the board and it is won by the participant who moves the furthest on the board with the number of data blocks they have left. As children play the game, they encounter challenges, which represent the trade-offs that they have to make when they navigate a social media application. For instance in the "LikeUp" challenge, the participants have the possibility to gain 100 likes on their photo if they choose to give away some of their data blocks (see Figures 2 and 3).

Reflection is an integral part of the gameplay and throughout the game, the guiding moderator asks the participant to share their reasoning each time they have to make a decision. Once the game ends, participants are asked to reflect on the decisions they made and the number of data blocks they accumulated through a brief interview.

2.1 Tangible components of the game:

DataBlokken consists of various tangible components, each made out of materials that can be found in a classroom setting.

- The game board is a life-size representation of a social media application. The board measures 4 x 4 metres, with a total of 36 squares. It is made out of cotton, with foam sewn into it, allowing the participants to play barefoot on a soft surface (see Figure 1). Each square represents a single step of the game and can contain a challenge point or arrow. These are placed on top of the squares and can easily be moved or shuffled between games.
- There are eight cardboard arrows, in violet with blue borders. Arrows represent a decision moment for the player and are spread across the board. Each arrow faces upward or downward. An upward arrow allows a player to move towards the



Figure 2: The "LikeUp" challenge as it is presented to the participants. The challenge point, made out of styrofoam and painted violet, has colourful balls glued on it, each representing a "like" on their profile.

end of the board taking a shortcut, but only if they decide to leave a data block behind. A downward arrow gives a player the choice to move back on the board, in exchange for recovering a data block.

- There are twelve challenge points in styrofoam and painted in violet on top and blue on the bottom. Challenge points are placed on the game board squares, and represent challenges children can opt into. The physical appearance of each challenge point is customised to represent the nature of the challenge. One challenge for instance is that a player can check how many participants have viewed their profile. Accordingly, its challenge point has googly eyes glued on it in a playful manner. The challenge points are accompanied by twelve challenge cards outlining what action the participant needs to take. The challenge points are accompanied by twelve challenge cards outlining what action the participant needs to take.
- There are 48 yellow cardboard stars. Each challenge point hides four stars so that one is available for each participant when they take part in a challenge. These stars are a tangible representation of the number of challenges the player participated in.
- There are eight data blocks per participant. Each data block represents a piece of personal data of the participant and each participant has a different colour.
- There is one large dice that allows participants to move forward on the board. Participants move forward following a snake-like pattern, starting on the bottom right square of the board and ending on the upper right square. This allows them to cross each square on the board.

2.2 Gameplay

At the start of the game, the moderator shares the rules of the game so that participants know how they can win the game, but not what its learning goals are.

Step 1: The participants choose the colour of their data blocks and are told that each of these data blocks represent a piece of personal data. Each participant starts the game with eight data blocks. Throughout the game, personal data are referred to as secrets.

Step 2: The game starts on the first square of the game board, where participants have to take the only compulsory challenge of the game. This challenge is compulsory as to mirror the action of signing up for an account on a social media app, an action which in real life also typically requires sharing basic information about oneself. To participate in the challenge, they place one of their data



Figure 3: In order to take the challenge, the participant has to flip the challenge point and take a star. The bottom side of the challenge is painted blue and hides 4 yellow stars.

blocks on the square, flipping the challenge point and taking a star from under the challenge point. Whenever someone has to place a data block on the game board, they have to share a secret about themselves with the group.

Step 3: One by one, the participants are invited to throw the dice and move across the board. By throwing the dice, they can land on a challenge point. If they accept the challenge, they have to give up a data block by placing one on the square and share a secret of their choosing with the group, receiving a star in return. The stars they accumulate allows the participants to have a tangible representation for the number of challenges they took. While the stars do not have another direct value in the game in its current version, the moderator also uses them to probe participants in the final interview about their engagement with the game. They also have to flip the challenge point if they decide to take the challenge thus revealing its blue, bottom side. This helps identify which challenges have been taken throughout the game and also helps the reflection discussion at the end (see Figures 4 and 5).

Step 4: If a participant lands on a square with an upward arrow, they can choose to move up the board faster. If they decide to do this, they have to leave behind a data block, share a secret, and they do not receive a star in return. If they land on a square with a downward arrow, they can win back a data block by moving down a few squares. At the end of the game, a data block can be exchanged to move up two squares. Accordingly, when confronting an arrow, the participant has to estimate the cost of this trade-off for themselves.

Step 5: When the first participant crosses the middle of the board, the moderator asks all participants to count out loud the number of data blocks and stars they have. This is done to encourage reflection on their progress and the progress of their peers, as well as to probe on the value of the data blocks and the stars.

Step 6: The game ends when the first player lands on the final square.

Step 7: At the game end, each player has to count how many data blocks they have left. For each data block they have left, they can move up the board two squares. So the first person to reach the final square is not necessarily the winner as other players can overtake them by moving squares with their data blocks. If two or more players land on the final square, the player with the most data blocks left wins.

2.3 Eliciting Reflection

As stated previously, the goal of the game is not to teach the participants about what constitutes a “good” or “bad” decision, but rather to teach them to motivate the decisions they can make. Accordingly, the moderator’s role is to stimulate reflection when participants ar-

rive at a square where they have to make a decision (i.e. a square with a challenge point or arrow). Therefore at milestone moments the moderator asks participants to count out loud the number of data blocks and stars they have. Aside from encouraging reflection, the moderator reads the rules of the game and the challenge cards out loud, answers questions of participants and documents the game results. Otherwise, they do not interfere with the gameplay, and they take a neutral stance with regard to the choices participants make. At the end of each game, the moderator conducts a semi-structured interview with all participants, with the goal to gauge the participants’ understanding of the gameplay, relation to the learning goals, opinion about their own participation and that of their peers, and thoughts about the design of the game.

3 PRELIMINARY FINDINGS AND DISCUSSION

We tested DataBlokken in a school setting with 21 children between the ages of nine and eleven in six groups of three to four participants. Each game lasted around 30 minutes. The participants were all part of the same class and the game was organised during their school day, with a teacher present in the neighbouring classroom. We tested the game in a setting where the children knew each other. After each game, participants were briefly interviewed by the moderator following a semi-structured protocol probing their experience of the game, the decisions they made and the secrets, they shared with the group. Prior to the organisation of the DataBlokken tests, we sought informed consent of the guardians of each participant. Additionally, ethical research protocols with regard to data protection were submitted and approved by the KU Leuven Social and Societal Ethics Committee.

Although preliminary, findings from this study seem to suggest that the DataBlokken game stimulates children between the ages of nine and twelve to reflect critically on the value of their personal data, and empowers them to articulate how and why they make decisions with regard to sharing their personal data on social media platforms. Participants seemed to clearly understand the rules of the game and the meaning ascribed to each of the tangible components. Throughout each game, we noted that reflection was stimulated through engagement with the tangible components of the game, and that participants showed an eagerness to reflect and share their reasoning with their peers and the moderator. These findings point to the benefits of using physical tokens to stimulate children in participating in moments of reflection, thus supporting existing research that highlights how physical tokens can help people reflect on data [10].

In all but one game, participants decided to take around half of the challenges and arrows presented to them. Except for three participants, all participants participated in at least one non-compulsory challenge. While engagement with the arrows varied greatly between games, downward arrows were considerably more popular than the upward arrows and the challenges. Participants motivated the decisions they made in the game based on various reasons among which their personal game strategy, curiosity about the content of the challenges, and a more desire to have fun. While almost none of the participants shared a preexisting interest in the topic of data protection, they still showed a complex understanding of the consequences that sharing data online can have. All participants expressed an appreciation for its playful character and the nature of the challenges. They also mentioned their enthusiasm about the fact that the game is life-size, its overall “look and feel” and its materials. Throughout the game, participants actively engaged with the board and its components, for example by touching a challenge point while deciding whether or not they wanted to take a challenge, or dabbing the board with hands and feet when reaching a new square. In line with research on the role of play(fulness) in the promotion of (creative) data literacy in higher education [13], the findings suggest that children between the ages of nine and twelve also benefit from

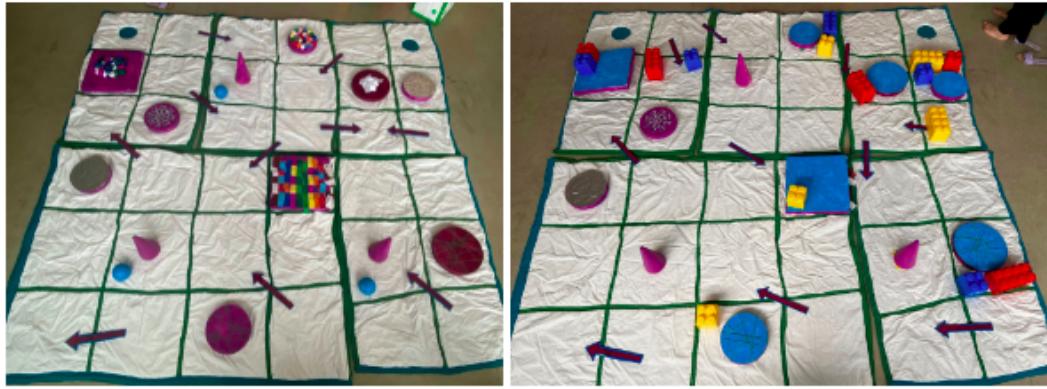


Figure 4: (left) The DataBlokken board before a game session. Participants start from the top right corner on the square with a point and make their way to the top left corner. (right) The DataBlokken board after a game session. Note that seven challenges have been taken, with the compulsory challenge on taken by all three participants as is indicated by the three color data blocks on that square.

the integration of playful elements into educational resources that intend to stimulate their critical thinking related to privacy and data protection.

4 CONCLUSION

We presented DataBlokken, a life-size data physicalisation game that guides participants between the ages of nine and twelve through a series of challenges that gauge their understanding of critical data concepts and activates their sense of agency over the processing of their personal data. We tested and evaluated the use of DataBlokken with 21 participants. Early findings seem to indicate the game stimulates participants to reflect on their relationship with their personal data, that participants enjoy playing the game, understand the rules of the game well and appreciate size and DIY-look and feel of the game. We believe that DataBlokken can contribute to educational efforts related to critical data literacy by demonstrating the potential of data physicalisation games. Evaluation of the DataBlokken game is ongoing and will elucidate how the learning objectives of the game are met. Based on our preliminary findings, we are working on future iterations that add complexity to the learning goals of the game as well as test it outside of a school setting. Specifically, we will test iterations of the game wherein participants will be asked to differentiate between data types and assess which types of data are more valuable within the universe of the game. Future iterations could also expand on the physicalisation of data beyond identical-looking LEGO blocks, the types of challenges presented to participants, and the role of the tangible incentives in the game.

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