

Fostering Data Literacy Through the Delta i Data! Game Package: Teacher Insights

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Abstract: As digital technologies and data-driven systems are integrated into our daily social, study, and work life, fostering critical awareness of data collection becomes increasingly essential. K-12 teachers play a key role in building students' data literacy through engaging and inclusive activities. Analogue games have proved valuable for active learning and group interaction. Seeking insight into how analogue game-based learning can support teachers in fostering students' data literacy, this paper presents a case study examining how 20 upper-secondary teachers experienced using *the Delta i Data! Game Package*. Containing two analogue data literacy learning games and additional teaching resources, the game package was developed as part of a University-County Council collaboration and distributed to 42 upper-secondary schools in Norway at the beginning of the 2024 school year. An online qualitative survey conducted two months later investigated how upper-secondary teachers implemented the games in their classroom practices. Thematic analysis revealed four key findings: First, the teachers' use of the games differed. Second, the games contributed to student engagement and social interaction. Third, the games fostered data awareness by providing a good starting point for discussions on privacy concerns, data trails, and the role of digital data in everyday practices. Fourth, some teachers found it challenging to facilitate digital data reflections, while others chose to use the games solely for relationship building and did not address data literacy with their students.

Keywords: Educational games, Analogue games, Data literacy, Social interaction, Teachers' experiences

1. Introduction

Digital technologies have profoundly transformed the way we create and share information, as well as how we interact socially. Tracking technologies embedded in digital environments are used to collect large amounts of data, promising effectiveness, content tailoring, and personalisation (Pangrazio & Selwyn, 2023). While offering numerous affordances, these developments also pose risks. For instance, gamified algorithms designed to keep users' attention can lead to increased use, which in some cases can be linked to higher stress in adolescents (Smahel et al., 2025). Furthermore, increasing use of digital technology has not automatically led to higher levels of digital competencies or data awareness (Datatilsynet, 2024; Fraillon, 2024). *Data literacy* involves understanding how and in what contexts digital data is generated, collected, and used, and is essential for navigating current data infrastructures and implementing future datafication processes responsibly (Pangrazio & Selwyn, 2023). Gaining data literacy early in life is a significant advantage in today's digital world, and teachers play an important role in supporting all K-12 education students in developing digital skills, including competencies that extend beyond the practical use of digital tools (Vermeire et al., 2025).

The growing presence of generative AI systems, algorithmic, and data-driven technologies has led to a stronger international emphasis on using and understanding data as key competencies for active and responsible participation in society (Van Audenhove et al., 2024). In Norway, governmental initiatives have prompted action at both the school and school owner levels to support teachers and students in navigating the responsible use of AI (UDIR, 2024). In this context, there is a need to provide inclusive and engaging data literacy learning opportunities that reach across diverse student groups.

The Delta i Data! (DiD!) Game Package is a game-based learning initiative for data literacy, developed in collaboration with Vestland County Council in Norway as part of a broader initiative to support teachers' work with AI-related topics. In August 2024, 147 *DiD! Game Packages* were distributed to all public upper secondary schools in the county with the aim of promoting data literacy through playful classroom interaction. Each package contained a class set of two analogue learning games, and additional teaching resources were made available through a website.

This paper presents a case study aimed at understanding how analogue game-based learning resources can be used by teachers to foster students' data literacy. An online qualitative survey was conducted among upper-secondary schools two months after they had received *the DiD! Game Package*, to investigate teachers'

experiences with the resources. The paper presents findings from a thematic analysis of responses from 20 teachers from 14 different schools who had used the games in their classes, involving a total of 628 students.

1.1 Background

Educational games can be valuable tools for supporting critical reflection and awareness of digital data (Castañeda et al., 2024; De La Hera et al., 2024), due to their immersive and motivating qualities and potential for active learning (Arnab, 2020). Analogue games, including tabletop, card, and board games with little or no digital gameplay, are often designed for ‘face-to-face gameplay’ in social settings (Bayeck, 2020), and have shown potential for meaningful learning through group interaction and communication (Sousa et al., 2023).

According to a review by Bado (2022), teachers pedagogically frame the use of games in teaching and learning situations through structured activities *pre-game* (e.g., gameplay training, lectures and handouts), *during game* (e.g., scaffolding content, classroom management and technical support), and *post-game debriefing* (e.g., guided discussion and reflection). Despite the importance of post-game debriefing for learning, the review showed that this phase received the least attention in studies of teachers’ instructional practices when using games (Bado, 2022).

Previous studies on games for digital literacy have demonstrated its relevance for learning about privacy and online safety (Henriksen-Bulmer et al., 2024), internet cookies (Diez & Melcer, 2020), fake news and cybersecurity (De La Hera et al., 2024), and artificial intelligence literacy (Du & Wang, 2023). While the field of research tends to focus primarily on digital games, some studies have addressed the educational potential of analogue games for computational thinking (Bayeck, 2020), digital literacy (DeJong, 2023), and data literacy (Lameras et al., 2024).

2. The Delta i Data! Game Package

The DID! Game Package (Figure 1) is a ready-to-use teaching resource designed to promote data literacy. It was developed and designed by researchers as part of the EduTrustAI project at the Centre for the Science of Learning and Technology (SLATE), University of Bergen, and adapted for upper secondary education contexts in dialogue with Vestland County Council in Norway, as part of a broader set of initiatives aimed at supporting schools’ work with generative AI.



Figure 1: The DiD! Game Package

The game package includes two physical analogue games: *DataDelta* and *Data Iceberg* designed with the aim of fostering a basic understanding of digital data and raising awareness of (1) that we constantly create *data footprints* when we interact with digital devices, and (2) that there are different visible and invisible *data types* (SLATE, 2024). The original versions of these games were developed within the EU Erasmus+ project Data Literacy for Citizenship (DALI, 2023) as part of a toolkit of 11 games designed to support adult learners’ data literacy (Castañeda et al., 2024). Two of the DALI games (Game of Phones and Data Iceberg) were further developed, piloted, and playtested for use in Norwegian upper secondary education, resulting in *the DiD! Game Package* versions *DataDelta* and *Data Iceberg* described in the following (Figure 2).

DataDelta is a card game that prompts players to use their phones to look up and share online content. While practising skills relating to the use, access, and communication of digital materials retrieved from online sources (DALI, 2023), the players also engage in social interaction and get to know each other. The aim of the game is to provide a foundation for post-play reflection on how all digital actions generate data footprints.

Data Iceberg is a memory game where players uncover and categorise everyday scenarios to reflect upon and increase awareness of how visible and invisible types of digital data are generated (SLATE, 2024).



Figure 2: Game impressions for *DataDelta* and *Data Iceberg*

Including the two games in the game package was intentional. While *DataDelta* creates engagement, curiosity, and prompts concrete digital actions ideal for post-game reflections, *Data Iceberg* introduces defined concepts about data types. These two games complement each other: the first game sets the stage for reflection, while the second helps students develop a conceptual understanding. In this way, the games function as pre-play and post-play activities for each other (Klykken, 2025).

The box is supported by a website with free supporting materials (SLATE, 2024), which had 4,891 unique pageviews and 646 downloads between August 2024 and July 2025. It offers digital and printable games, a teacher's guide, ready-to-use presentation slides, and a suggested lesson plan. The objective of the 2 x 45-minute lesson plan (Figure 3) is to support students' basic understanding of digital data through play, reflection, and discussion, by combining gameplay with pre-play teacher-led instruction, and post-gameplay group activities.



Figure 3: Suggested lesson structure using *the DiD! Game Package*

Before the autumn semester of 2024, a total of 147 physical *DiD! Game Packages* (pictured in Figure 1) were distributed to 42 upper-secondary schools in the county. Targeting over 8200 first-year students, each box contained both games and enough materials for 32 players. In collaboration with the County Council, the game package was promoted to support not only data literacy, but also social relations. This dual emphasis was chosen to appeal to a broad range of teachers, including those who are mainly looking for activities for building a socially constructive class environment. While teachers were encouraged to use the game package for data literacy and relationship building during the introductory week, they were free to use it as they saw fit.

3. Methodological Approach

The overall objective of this study was to explore how teachers can utilise analogue game-based learning to foster students' data literacy. Specifically, we investigated this through a case study examining teachers' experiences when integrating *the DiD! Game Package* in their classroom teaching, and their reflections on how its use contributed to students' data literacy as well as to the social environment. The study is guided by the following research question:

RQ1: How do upper-secondary teachers experience using the Delta i Data! Game Package as part of their teaching?

We employed a case study design, suitable for exploring a single case in depth while capturing the complex context of the specific initiative. (Simons, 2009), and an appropriate approach since the teachers' experiences were deeply embedded in the application of specific games during a particular time.

An online questionnaire was designed, containing both quantitative and qualitative, open-ended questions, allowing for rich responses, descriptions, and reflections on their actual use (Braun et al., 2021). The questionnaire asked teachers to evaluate the game package on a five-point Likert scale regarding their perception of the games' usability and impact in terms of fun and engagement, relationship building, and learning about digital data. The questionnaire also asked how many students and with what intention the games had been used. In the open-ended questions, the teachers were invited to provide in-depth descriptions and examples of their experiences, including how the games were integrated into their teaching (e.g., what did and what did not work), as well as assessing their educational value.

The game packages were distributed to schools for the start of the term in August 2024. Two months later, we sent out the survey to the 42 upper secondary schools that had received the games, asking school administrators to share it with teachers and other relevant staff who had direct experience with using the games. We employed a purposeful sampling strategy (Simons, 2009), inviting only teachers who had used the games, while targeting multiple schools. This approach aimed to provide relevant insights into the specific case, while capturing geographical broadness in terms of how teachers at different schools across the county experienced the package.

For the analysis of the open-ended responses, we employed a thematic approach, searching for patterns and contrasts, and constructing themes to represent the recurring and varied ways the games were used and experienced (Braun et al., 2021).

The research followed ethics guidelines, including the principle of informed consent (Roberts & Allen, 2015). The email invitation and survey provided potential participants with information concerning the study's purpose, the estimated time to complete the survey, that participation was voluntary and anonymous, and that no identifiable information would be collected or shared.

4. Findings

Twenty teachers (including two department leaders) from 14 different schools responded to the survey. Together, they reported using the *DiD! Game Package* with a total of 628 students across both general study and vocational programmes. We constructed four themes during the thematic analysis: 1) *Variation in use*, 2) *Contributing to engagement and relationship building*, 3) *Fostering data awareness through discussions*, and 4) *Challenges in facilitating digital data reflections*.

4.1 Variation in use

The survey responses revealed variations in how teachers used the game package. Regarding the number of games, we found that 60% of the teachers used only *DataDelta*, whilst 40% played both games. The time spent on activities involving the games ranged from 20 minutes to 3 hours, with an average time of 72 minutes.

The purpose of use also varied. 67% of the teachers reported using the games with the intended dual purpose to simultaneously be a social and learning activity (aligning with the original intention of the package). This was also reflected in open-ended responses, such as one teacher who noted:

"The games were used as an icebreaker activity with discussions about data sharing. For example, social media, advertising, web searches, location data, and cookies."

In contrast, 33% reported using the games solely for relation-building purposes. The open-ended responses also show that several teachers used the games as primarily a social activity for the students, with one teacher commenting:

"I didn't use them as educational games, only to 'shake' the class together at the beginning of the year."

Some teachers adapted the games. While 60% reported using the provided teacher's guide, some open-ended responses reveal that some teachers integrated the games into teaching activities in different ways to better fit their needs. For example, one teacher asked students to write reflection notes about their data usage and security. Another adjusted the games to fit a different learning topic.

While several teachers reported using the games in small groups within singular classes, one of the teachers described using the games to build relationships across different first-year classes:

"The main goal of the game session was relationship building and getting to know each other across classes in 1st year upper secondary."

4.2 Teachers' Views: The Value of the Games for Building Relationships and Data Literacy

Table 1 provides an overview of the teachers' experiences with *the DiD! Game Package*, based on their responses to Likert-scale items. The results show that the package was perceived as engaging, easy to use, easy for students to understand, and effective in contributing to relation building and social environment. However, the contribution of the games to learning about digital data was rated somewhat lower than the other areas.

Table 1: Participants' mean ratings of DiD! game experiences (Scale: 1 = very low, 5 = very high)

To what degree did you experience the games as: (N=20)	Mean
... easy to use (for the teacher)	4.6
... easy to understand (for the students)	4.4
... fun and engaging	4.3
... contributing to relation building and social environment	4.4
... contributing to learning about digital data	3.6

To further understand these findings, the following sections focus on the open-ended responses relating to the game package's value in supporting social interaction and fostering data literacy.

4.2.1 Contributing to engagement and relationship building

A key theme in the teachers' answers was that the games facilitated student engagement and relationship building, with nearly all the teachers describing the games as contributing to student engagement and social interaction. Teachers describe especially the first game, *DataDelta*, as an effective icebreaker and "a good way for the students to get to know each other". One teacher described how the students "learned a bit about each other, what they liked and didn't like, and so on".

Several teachers specified that the analogue game-based approach provided a safe context for communication and learning. One teacher reflected that students seemed to be comfortable 'having something physical in their hands' while interacting. Another stated that:

"The game was very concrete and harmless. Everyone participated :) The students got to know each other and had a positive experience together."

One teacher described that using the game package in small groups provoked positive interaction and laughter, concluding that:

"It worked well, reservations to share and the 'fear' of embarrassing themselves disappeared quickly."

4.2.2 Fostering data awareness through reflection, conversations and discussions

Another theme was that the games were beneficial for increasing awareness of the sharing of digital data. One teacher stated that the students seemed to have "become more aware of what they allow their apps to collect information about". Similarly, another teacher stated:

"The students became more aware of digital traces and how quickly information can be found."

Several teachers reported that the games provided a good starting point for learning about data trails, particularly through enabling reflection, conversations and discussions. One stated that the games "contributed to interaction, and reflection based on a shared understanding and belonging". Another teacher wrote that the games provided:

"A good starting point for discussing the importance of privacy and being mindful of the data one shares."

Two teachers also reported on their own professional learning and increased awareness about students' digital practices. The first teacher reported learning about how students searched for information online, and the second teacher explained that the games were: "Useful for the teacher to get to know the students' digital everyday lives".

4.2.3 *Challenges in facilitating digital data reflections*

As detailed (see Section 4.1), several teachers chose to use the games solely for relationship building and did not directly address data topics with students.

Additionally, some teachers reported challenges in facilitating students' reflections and discussions about digital data. One teacher explained that, during *Data Iceberg*, the students became very focused on "playing memory" and that instead of discussions about types of data, there was "laughter, accusations of cheating, and so on". The teacher reflected that the students "spent more mental energy trying to remember where things were than thinking about different types of data" and suggested removing the memory element.

Another teacher experienced difficulties in facilitating reflective discussion about data, reflecting on the role of the pre-play introduction:

"The students enjoyed themselves in the groups and spent all the time on the game. I perhaps should have been clearer that this also related to digital skills, as there wasn't a very reflective discussion around the questions once the game was completed."

5. Discussion

The above findings highlight how teachers experienced using the *DiD! Game Package* in different ways, reflecting their priorities, classroom contexts and student needs. We identified four analytical themes: 1) *Variation in use*, 2) *Contributing to engagement and relationship building*, 3) *Fostering data awareness through discussions*, and 4) *Challenges in facilitating digital data reflections*.

The first theme was the *variation in use* regarding the number of games, time spent, purposes, adaptations, and integration. On one hand, these differences could be understood as stemming from the game package's double purpose encompassing both data literacy and students' social interaction, and that the teachers were free to use the games as they saw fit with their students. The timing of the survey may also be influential, as it was conducted two months after the teachers received the game package. Trialability has been identified as a key factor for teachers' adoption of games (Kebritchi, 2010). In this case, the teachers were encouraged to use the games during the introductory week and thus had limited time to experience the games themselves beforehand.

On the other hand, *variation in use* could also be interpreted as a sign of flexibility in the game package materials. A review by Bacsa-Károlyi & Fehérvári (2024) identified time constraints and the lack of adaptability of games as important *institutional* factors hindering teachers' gameful practices, alongside inadequate materials and a lack of professional development opportunities. *Individual* factors include teachers' attitudes, such as confidence in the advantages of using games or belief in games increasing student motivation (Bacsa-Károlyi & Fehérvári, 2024).

The second theme was the *games' contribution to engagement and relationship building*. The teachers reported that the students became engaged, started good conversations, and got to know each other. The analogue, physical concreteness of the games was also described as contributing to a safe learning environment. This resonates with existing literature on the social and immersive spirit of games and the construction of failure as harmless and safe (Ness et al., 2024; Whitton, 2018).

The third theme was *fostering data awareness through reflection, conversations and discussions*. Teachers describe the game package as providing a good starting point for learning about digital data through conversations, discussions and reflection. The potential for learning opportunities can be connected to research highlighting social affordances of analogue learning games (DeJong, 2023; Sousa et al., 2023). Bayeck (2020) argues that board games serve as alternative learning spaces, facilitating learning beyond knowledge acquisition as players interact and engage in various social practices within specific game environments.

Interestingly, the games also contributed to teachers' understanding of students and their digital lives. During gameplay, if students are encouraged to talk and reflect on their everyday online practices, this can make the students' level of awareness about data more accessible to the teacher. This highlights the indirect potential of analogue learning games to increase Teacher-Student dialogues about digital data, and consequently, improve the teacher's capacity to adapt future data literacy activities to fit students' learning needs.

The fourth theme concerns *challenges in facilitating digital data reflections*, as some teachers observed imbalances between entertainment/fun and learning when using the games. Such imbalances may be linked to design issues within the games themselves, as well as to individual player traits and preferences (Arnab, 2020). Not clearly communicating the learning aim of the game activity before playing was mentioned by one teacher

as contributing to low reflection levels. This aligns with a study by Sanchiz et al. (2024), which argues that providing the purpose of learning beforehand is crucial to prevent playful and fun elements from overshadowing actual learning during the activity, particularly when students have prior gaming experience (Sanchiz et al., 2024). Research on the impact of students' understanding of the game context also emphasises the need for pre-play, in-game, and post-game activities (Bado, 2022; Kim & Pavlov, 2019). However, overemphasising instruction and scaffolding during learning games may undermine qualities of immersion, autonomy, and surprise that are essential for engaging and motivating playful learning experiences (Arnab, 2020; Barendregt, 2014; Sharp, 2012).

Jobert and Sanchiz (2025) argue for the importance of developing teachers' professional knowledge in using games for learning, for instance, to foster teachers' skills in implementing and adapting game-based activities to meet the specific needs of a particular class. While the previous experiences of teachers were not the focus of this study, the findings can be seen to support the existing research's emphasis on teachers' knowledge of how to implement learning games, and overcome potential barriers, identify benefits and limitations of using and adapting games in diverse teaching situations (Bacsá-Károlyi & Fehérvári, 2024; Bado, 2022; Hébert et al., 2021).

6. Conclusion

The teachers reported that using the *DiD! Game Package* created opportunities for social interaction and supporting data literacy. The findings show a variety of uses as teachers adapted the games and activities to their students' and group needs, different learning aims, and other situational aspects. This shows that distribution cannot guarantee how educational games and related resources will be used in practice. Getting an overview of the various ways the games were used could inform future iterations of the package and lead to a more varied and broader range of supporting materials. Limitations of this study include its reliance on online surveys and teachers' self-reports. Future research could incorporate students' experiences and utilise qualitative interviews and observations to provide more depth and nuance.

The digitalisation of everyday activities occurs across formal and informal settings, and digital practices are often deeply socially motivated, even in educational contexts. With the current rise of AI and data-driven systems, raising awareness among all students about the impact of our digital actions across multiple platforms and activities seems even more crucial. Hence, the informal sociality and playfulness of analogue game-based learning environments, such as *the DiD! Game Package*, appears to provide a relevant and productive approach for teachers to support students' data literacy.

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