Inspiration Cards Workshops with Primary Teachers in the Early Co-Design Stages of Learning Analytics

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ABSTRACT

Despite the recognition of the need to include practitioners in the design of learning analytics (LA), especially teacher input tends to come later in the design process rather than in the definition of the initial design agenda. This paper presents a case study of a design project tasked with developing LA tools for a reading game for primary school children. Taking a co-design approach, we use the Inspiration Cards Workshop to promote meaningful teacher involvement even for participants with low background in data literacy or experience in using learning analytics. We discuss opportunities and limitations of using the Inspiration Cards Workshops methodology, and particularly Inspiration Cards as a design tool, to inform future LA design efforts.

CCS CONCEPTS

• Human-centred Computing • Interaction Design • Interaction design process and methods • Participatory Design

KEYWORDS

Learning Analytics, co-design methods, inspiration cards, emerging technology

1 Introduction

A strong seam of research has looked into the potential pedagogical activities that Learning Analytics (LA) may support in classroom learning. Much of this research has engaged in theoretical work through the lens of education theories and existing concepts of educational practice (e.g. [26, 31]). Design-oriented approaches where teachers and designers alike work together to uncover the opportunities of LA has been less common, but yet equally important [34].

Whereas theoretical perspectives can provide, for example, input into how LA might benefit teaching activities, they cannot always capture the complex realities of education practitioners or their visions of learning and teaching, nor can they empower them to become active participants providing input to the future direction of LA. Among the many barriers to the design-oriented research have been the lack of design methodologies, especially for the early exploratory stages of the design process and for involving non-expert stakeholders with little understanding of the potential of technologies and their data. Most importantly, it is in these stages of design that the knowledge produced is generative and has the potential to inform broader modes of thinking and future design practice [15].

The present work seeks to address these gaps in the context of a case study involving an ongoing design project tasked with developing LA tools for an early learning literacy game. Taking a co-design approach, we use the Inspiration Cards Workshop methodology (see [14]) to understand teachers’ needs, desires and challenges to design and implement meaningful analytics for their practice.

This paper contributes to the LA community by discussing methodological strengths and trade-offs of using the Inspiration Cards Workshops to involve practitioners with low experience with LA tools in the early stage of the design process. Particularly, we discuss the role of cards as a design tool for LA co-creation. These insights can inform future LA design efforts, and more broadly inform the design of data-rich technologies in education.
2 Background

2.1 The Role of Teachers in LA Design

One of the drivers behind the emergence of Learning Analytics (LA) tools for teaching and learning has been the growing recognition that learning with technology is most likely to occur with appropriate teaching and scaffolding [40].

Accordingly, it has been argued that the data provided through LA tools can raise teachers’ awareness and reflection, informing their decision-making and consequent behaviours in the classroom [26, 29, 42, 43]. LA tools typically allow the tracking of students’ progress, the class’ workflow and support class management [25]. Research on LA has chiefly focused on enhancing the effectiveness of teachers’ orchestration of the classroom and its inevitable variability and complexity [6, 29, 31]. For example, Martinez-Maldonado et al. [26] proposed a framework that captures, among other pedagogical aspects, four orchestration activities that may be supported by LA: design, adaptation, awareness and management.

Despite the pedagogical aspirations of such tools, however, the central role of data science in the context of LA has meant that researchers have often focused on the necessary algorithms involved in operationalizing LA as opposed to understanding the pedagogical needs that these algorithms should serve [1, 6, 15].

A recent design model seeking to address this gap is the LATUX workflow [25]. In developing LA tools for educational contexts Martinez-Maldonado et al. recognise the importance of “carrying out research to explore the new possibilities that learner data can offer for supporting instructors”. The LATUX workflow describes how an iterative human-centred design process is instantiated in the case of LA. The model identifies an initial problem identification phase for LA, followed by a series of iterative formative evaluation stages.

However, despite the recent recognition of the need of human-centred design processes in LA [19] for integrating teachers’ perspective, teacher input tends to come later in the design process [1, 15]. For instance, previous work has involved teachers to understand how existing LA tools can be effectively used (e.g. [27, 37]) or gathering their feedback on existing LA tools. With a few rare exceptions (c.f., [21, 15, 16, 29]), teachers do not tend to participate in empirical studies aiming to define the initial design agenda with them. LATUX, in particular, does not provide methodological guidance on how to support user involvement in the early generative design phase.

Recently, research in the LA field has started to explore the potential of design methodologies and tools to meaningfully involve stakeholders, which we review next.

2.2 Generative Design for Learning Analytics

Considering the complexity of LA systems, previous research has identified barriers impeding stakeholders’ meaningful contribution to the LA design process. For instance, Martinez-Maldonado et al. [23] and Mavrikis et al. [28] discuss that learners’ and teachers’ limited understanding of data processing and visualisation techniques, and lack of data literacy hinders participation. In their work, they also provide rich case studies of LA design processes that involve users in frequent consultations and testing.

However, as Holstein et al. [16] pointed out, co-designing LA systems with stakeholders in an effective way requires generative design tools and techniques that overcome possible barriers. In this and previous work Holstein et al. [18] described an early co-design approach with the aim to design a dashboard that answers real-time teachers’ needs in the context of an intelligent-tutoring system (ITS). Overcoming concerns about data literacy, twelve K-12 teachers with 5 years of experience with ITS participated in a series of three workshops by addressing teachers’ current needs, desires, and constraints. Other available examples focused on later design phases. For instance, Könings et al. [18] reported the use of co-design sessions to integrate student perspectives on current learning environments to improve the learning experience.

Thus, despite a frequent call from scholars to integrate more co-design or co-creation approaches in the generative phase of LA (e.g. [24, 4, 7]) there are only few detailed accounts of co-design processes for LA similar to [15]. From a theoretical point of view, unpacking co-design processes requires an epistemological shift from objective analysis of design requirements towards the consideration of the complexity of participants’ voices – researchers included – their contexts and design materials to contribute to a co-constructed design process. As Dollinger et al. [8] pointed out, the transparency of the researchers’ perspectives, values and goals in underpinning decision-making is one of the current gaps in LA research.

In regard to methodologies, a few recent examples have proposed specific approaches for LA. Building on previous LA and HCI efforts, Holstein et al. [16] created a new prototyping methodology, Replay Enactments, to involve teachers in this LA design phase and allow them to experience different representations of data in order to collect early feedback. Prieto et al. [32] proposed two conversational frameworks and an inter-stakeholder communication tool that can help externalise and discuss perspectives on data, learning and technology more broadly.

As regards the early generative phase, methodological guidance is very limited. Recent contributions have also proposed cards as design tools for co-designing LA with teachers. For instance, Prieto-Alvarez and colleagues have organised a workshop to propose their ‘LA-DECK’ set of cards as a tool to involve stakeholders in LA design and possible mean to unpack the design process [35]. Schmitz et al. have developed a board and cardgame that can be used in workshops to connect learning analytics and learning design, which can also act as tool for measuring teacher or student behaviour [44].

The detailed case study illustrated next adds to the emerging body
of research in the LA field exploring how design-oriented approaches can promote teachers’ participation in the early generative phases of design of LA tools.

3 Methodology

3.1 Case Study

"Navigo: the Pyramid of the Lost Words" is a reading game within which the player takes on the role of an archaeological adventurer, intent on unlocking the secrets hidden within an ancient and mysterious pyramid through completing learning activities focused on different areas of reading skill development. The game incorporates 16 different mini-game mechanics, which have been designed to develop reading skills across six language levels, namely Phonology, Morphology, Word Recognition, Orthography, Syntax and Morphosyntax. Each of the six language levels comprises linguistic features that form part of a domain model of reading underlying the game. Within each pyramid room the player encounters a series of different mini-game activities which focus on a combination of reading skills targeted at the players’ current level in order to develop their reading fluency. Based on the reading development literature, the 16 mini-game mechanics represent three types of activities:

Accuracy mini-games develop declarative knowledge through focusing on an individual language feature and rule (e.g. see Fig. 1a);

Constructing mini-games develop declarative/procedural knowledge through applying multiple linguistic rules in context (e.g. see Fig. 1b);

Automaticity mini-games develop atomisation through timed reading practice (e.g. see Fig. 1c).

For each linguistic feature they encounter, children progress between these three stages of reading by playing different game mechanics to achieve the goal of fluency for that feature.

3.2 Participants

Given our application of LA to the domain of literacy, and reading specifically, we sought to involve practitioners from different contexts who were supporting students with diverse literacy needs. Potential participants included primary school teachers, special education needs (SEN) teachers and SEN coordinators. Three different sessions were arranged.

In all three sessions participation was voluntary and all of the participants provided informed consent. Besides the practitioner-participants, each of the sessions additionally included two researcher-participants, one with expertise in literacy and the NaviGo games, and one researcher with knowledge of LA.

Session 1 (4 practitioner-participants): participants were four SEN and personalised learning experts, i.e., two ex-teachers who now delivered professional teacher training for dyslexia, one teacher-student participating in the dyslexia training and one speech-language therapist;

Session 2 (2 practitioner-participants): participants included a teacher working on literacy in Year 2, and the head-teacher who had a literacy background and taught literacy sessions occasionally. These two literacy practitioners were based in a school with a strong track record in supporting students who struggled with literacy;

Session 3 (4 practitioner-participants): participants comprised a Year 1 literacy teacher, a Year 2 teaching assistant, a Year 3 teacher and the deputy head-teacher who was also the SEN coordinator. These practitioners were based in a school adopting holistic approaches to literacy through developing their own curriculum.

3.3 Co-Design Workshops

We facilitated three workshops of around 1h15mins each, which were structured around three phases informed by Hornecker et al. [17].

3.3.1 Phase 1: Exploring existing practices

In facilitating a transition from current practice to new opportunities we started each session with a group discussion on
participants’ current data practices at school. Given their current training role, participants of session 1 were encouraged to draw on their past professional experiences with data. This phase aimed to generate a shared understanding between participants and researchers about (i) the nature of current data practices; (ii) how data are currently collected; (iii) the impact of those data on participants’ teaching practices.

3.3.2 Phase 2: Familiarization with technology

The second phase aimed to introduce the NaviGo games, and support teachers’ understanding of the domain model of literacy employed and the pedagogy that guided the game design (see Section 3). In particular, we selected three games from the three types of reading activities. First, we introduced each game type through a visual representation explaining the learning activity, instruction type, learning objective, game distractors and feedback information. We then asked participants to play each of the three games, whilst referring to the visual representation in order to link the pedagogical rationale with the game play experience.

3.3.3 Phase 3: Exploring new possibilities

The last part of the workshops aimed to support the identification of inquiries teachers wanted to pursue with the data produced by the NaviGo game. We prompted participants to generate new questions that could be answered with game data, to share with us the rationale of these questions, and how the answers obtained through the data would inform their teaching. We used these prompts to elicit teachers’ critical engagement with data and the possibilities it introduces.

By probing the ‘whys’ of particular pedagogical data uses, we faced the challenge of supporting teachers’ understanding of a potentially complex design space characterized by different reading phases, learning outcomes, possible data, and technical details of how they are processed. The Inspiration Card Workshop method developed by Halskov and Dalsgård was employed to address both requirements. In particular, we were drawn to this method because of its tangible and material form, and its potential to scaffold conversations that were closely coupled with what technology could achieve. An Inspiration Card is an index card presenting a space for a title, image and description. In combining two categories of cards, Technology Cards and Domain Cards, it is possible to uncover generative opportunities for technology design. While Inspiration Cards were conceived as a generative method, the original authors of this method explain that participants’ prior knowledge, experience, and practices shape the outcomes of the workshop [14].

Constructing the cards: Our first step was to design the cards. A Technology Card presents a specific technology or an application of one or more technologies. Given our focus, we designed the Technology Cards showcasing aspects of the NaviGo games and LA, namely the properties of the game activities (see Fig. 4, column 1), the possible game log data that could be captured (column 2 and 3) and the different possibilities for representing them graphically (column 4). Next, following Halskov and Dalsgård’s guidance, we recruited the support of two experts in literacy learning (both of whom also participated in Session 1) and collaboratively we created the Domain Cards. Domain cards represent important domain information such as relevant practices, or people and their characteristics. Our Domain Cards included the learning objectives relevant to the reading domain (column 5), the profiles of different students (column 6) and their classroom configurations (column 7), and finally the teaching methods used in literacy (column 8). Figure 3 captures the 30 cards designed.

Compared with Halskov and Dalsgård [14] whose cards were more ambiguous and open to interpretation, the existence of the NaviGo games meant that our cards showed specific aspects of the technology and its potential context of use. Despite this difference, we believed that the novelty of the LA technology, as well as the multiple data opportunities it introduced in the context of our participants’ experience, would foster clear generative opportunities. Furthermore, we encouraged participants’ proposals and different visions on LA possibilities by repeatedly reminding them of the possibility to create and use new cards whenever needed, as suggested by Halskov and Dalsgård [14].

Using the cards: Having designed the cards, we proceeded to run the three participatory design workshops in line with guidance reported in [14]. During each workshop, we displayed all of the cards on the table one by one, while describing their meaning and answering possible questions raised by participants. This allowed researchers and participants to negotiate a shared interpretation of each card. Following the introduction of the cards, we invited participants to combine them in order to co-construct pedagogical scenarios. In total this generated 14 new scenarios across the three workshops. Table 1 provides an overview on teacher ideas. Figure 3 shows a combination of cards that formed a scenario in one of the sessions where the teachers involved envisioned collecting data at a whole class level to inform the later organisation of smaller groups.
3.4 Data Collection and Analysis

Each of the three workshops was video recorded totaling 3.45 hours of video data. We used the inqScribe software to analyse the videos. Following Derry et al. [5], each video was broken down into segments representing each scenario envisioned through the new data-driven inquiries proposed. Next, thematic analysis was employed to shed light on the ways in which scenarios were constructed using the cards. In particular, we followed the 6 step method proposed by Braun and Clarke [3]: (i) we watched the video recordings multiple times, transcribing part of the data to note down initial ideas; (ii) coded the entire dataset systematically in a ‘data-driven’ way; (iii) collated an initial 24 coding categories into 8 themes; (iv) reviewed the themes iteratively, discussing possible biases in the interpretation, checking their expression of the full dataset; (v) refined the specifics and details for each theme, their title and the overall narrative of the analysis; (vi) selected meaningful extracts, relating back to the research question, literature and analysis. Through this process, we generated eight categories which capture teachers’ needs, desires and challenges at different levels and are presented below in Section 4. During the analysis, we also wrote down how participants used the cards in each scenario. The notes supported the methodological reflections discussed in Section 5.

4 Findings

4.1 Negative Experiences with Educational Technologies

Similar to Holstein et al. [15] whose teacher participants identified that their students sometimes lacked genuine engagement with technology, our teachers believed that the interactivity of digital activities could mask children’s lack of strategic engagement in their learning. In session 2, the headteacher explained that her school assessed literacy through STAR, a digital system based on multiple-choice assessment methods. While this was beneficial for centralising data to monitor student progress, it also led to trial and error approaches: “A lot of children were guessing (the correct response) and there was to no way to know where they were guessing […] They just sit there tapping around until they get some results.”

Whereas to show a holistic view of a student’s learning LA must collect data through continuous practice over a breadth of activities, the lack of control over how children independently engaged with digital learning activities led to a lack of trust in the technology. In turn, this prompted teachers to propose pedagogies that relied on bounded learning activities they themselves controlled, consequently impacting on the scope of data collected for use and further inference by the LA. As the headteacher in session 2 suggested “...it might be that the game (automatically) creates the learning pathway and then the teacher works on where they (the students) are with the game before you play that game. Because sometimes it is just play and play and play... and it is an assumption that... they are learning...”

4.2 Extrinsic Professional Demands Shaping Engagements with Data

Supporting past research that shows teacher expectations and effective use of LA are shaped by extrinsic factors [21, 27] teachers contextualized LA in the problems associated with the profession of teaching, and in particular the limited time and increased workload issues they faced. LA were therefore seen to ameliorate these problems by suggesting pedagogical actions that would have the highest impact, either by affecting the most students or those students who were at the highest risk.

While defining how to graphically represent students’ difficulties with word decoding during session 3, all of the participants agreed on the importance of gaining insights on trends within the class given their lack of time to engage with individual students. The deputy headteacher pointed out “Honestly, it (the LA visualisation) should be small groups of individuals, trends rather than whole class because we know ourselves that time is such a premium already...” This lack of time to engage with individual student data emerged during three occasions across the two other sessions, with participants suggesting a focus on data with a low level of detail, for example showing students’ performance on curriculum learning objectives allowing them to make swift connections with existing modes of teaching.

Moreover, teachers’ time limitations did not only shape what data they wanted from LA, but also how it would be delivered. Instead of them spending time querying the data, teachers wanted the technology to send them notifications to save time. For example, the teacher in session 2, sought both key classroom trends that would support planning at a class level, and data about students at risk. Sound and pushing information were key to drawing her attention to these insights: “it would be good to have like ‘ting ting ting’ 50% of students are struggling with the prefixes, so that I know that I need to work on the prefixes... Like a notification to the teacher...
saying ‘well this child is struggling’ and then maybe you go there and figure it out!”

4.3 Students’ Learning
Across all sessions, participants explained that children in the UK faced repeated literacy assessments and many found it particularly stressful when undergoing these. In contrast to this current situation, in session 1 it was suggested that technology could play an unobtrusive and critical role in accelerating the diagnostic identification of potential struggling readers. Moreover, the potential of data to support precision of such diagnosis prompted one teacher to foresee the opportunities for individualised support where quality teaching might proceed game play and practice: “…Performance on some items. For example, we can see which prefixes they struggle with, exactly. Which are the known ones and which are not. […] And maybe we can link this to the time. […] If it is about which suffixes and prefixes you can have like charts like group column charts. And in this case you can have a thing called precision teaching? Target the items from the outside while they progress with the game.”

Alongside the problem of diagnosing struggling readers, two participants reflected on the profile of struggling readers and their existing challenges with engagement and concentration. For example, during session 1, one of the teachers described how students who struggle with literacy must work intensively and persistently to gain fluency, a process that inevitably impacts the facilitative role of engagement in learning. As a consequence, she expressed an interest in using LA to ask “how long do they play (the game), to know about their concentration and engagement”.

4.4 Constructing Evidence-Based Small Group Sessions
In all of the sessions, our participants described their use of small groups as an effective method of teaching, and one that allowed them to provide differentiated planning or support. Students’ collaborative work was usually organised according to students’ levels of ability [22], with the teacher acting as facilitator and orchestrator of the different groups. LA were viewed as an evidenced-based approach to organise and update these small groups, a classroom activity also recognised in Martinez-Maldonado et al.’s pedagogical phases of ‘management’ and ‘planning’ [26]. As two of the participants in session 2 explained, LA can help to divide students according to their abilities, allowing for the planning of learning activities informed by the data: “maybe if it can generate reports on ability groups…” (…) “it would be interesting to know which are the strands, so that you know how they perform for each strand, in order to organise the groups better”. More broadly, this finding also confirms the pedagogical significance of previous research that focused on the design and development of digital tools to promote better similarity-based grouping in the classroom [13].

4.5 Enhancing individualized interventions
Individualized interventions target specific students’ learning needs with the aim to overcome the identified gaps through systematic, one-to-one teaching sessions [12]. Across all sessions, our participants recognised the value of this teaching method to improve specific aspects of reading a student may struggle with.

The speech therapist in session 1 imagined the possibility to diagnose a student’s learning gaps through standardised tests first and then use the games to ‘teach’ these skills, and assess students’ reading progress through the opportunities offered by LA: “you might want to do some standardised tests first that help you to decide what kind of areas you want to focus on... Some kind of diagnosis before and then target the intervention with NaviGo to train the skills. To master decoding then prefixes and suffixes then comprehension.” Similarly, the teacher in session 2 proposed a scenario in which a struggling reader uses the games as an intervention, with the teacher monitoring the effects of the game on learning through the LA tools: “So, you have an individual, problem with decoding. This is an intervention and you want to measure
how their decoding improves over time?”. Therefore, teachers naturally transposed the intervention model of high quality teaching onto digital technology. With games delivering an intervention aiming to support students with a familial risk of dyslexia, LA was considered to be an assessment tool used to monitor responsiveness, aligning with the design of similar technologies such as GraphoGame [36], whilst also supporting the potential of LA for assessment [9].

4.6 Enhancing Reciprocal Reading
Reciprocal reading methods aim to improve reading comprehension through students working together as a group on the same text. Typically, each student is assigned to a set of tasks related to the strategies of predicting, classifying, questioning and summarising the meaning, with these strategies rotating within each group [41]. During two occasions teachers identified the opportunity of technology to reinforce this teaching method, with LA monitoring if students’ comprehension improves as a result of reciprocal reading. For example, one participant imagined how this could fit into her current teaching process, describing the potential of the games and data to monitor and provide evidence-based awareness on the outcomes of the reciprocal reading sessions: “the comprehension stuff is about reading in groups... It would be nice to see how they score in the games and then they go in rotation in the (reciprocal reading) groups and then they go again in the games... to see if they do better. Something they do every week. And it would be nice to have a report on comprehension over time to see if they improve?”.  

4.7 Enhancing teachers’ self-assessment
In contrast to the theme above, where teachers sought to evaluate a particular teaching method, our participants also identified LA as a mechanism through which to obtain feedback on their practices. In session 1, this possibility to enhance teachers’ self-assessment in a data-driven way emerged twice. For example, one participant proposed to use the games after a teaching session to understand its effects on students’ learning, and then plan the following activities accordingly: “you can use NaviGo at the end of a session to assess your teaching... You use the learning analytics to inform what you did and then to structure the following activities”. This finding is similar to Holstein whose teachers asked for evidence-based insights on the effects of their own teaching on students’ learning [15].

4.8 LA raising the visibility of existing engagements and achievements
Previous research has shown there is a strong correlation between engagement and learning (e.g. [20]), suggesting that promoting students’ engagement generates a positive impact on their persistence in learning and learning outcomes. Embracing this view as part of their pedagogy, during session 3, teachers repeatedly identified engagement as the main goal of any pedagogical scenario. The digital data of learning outcomes captured in LA was broadly interpreted as a consequence of engagement, raising its visibility and thus reinforcing the school culture. It is in this spirit that

<table>
<thead>
<tr>
<th>What</th>
<th>Why</th>
<th>Pedagogical aim</th>
</tr>
</thead>
<tbody>
<tr>
<td>Knowledge of percentage of students struggling to achieve a learning objective</td>
<td>Teachers lack the time to explore individual student learning</td>
<td>Plan learning activities addressing the most common gaps in class</td>
</tr>
<tr>
<td>Representation of learning trends within the class</td>
<td>To have a class overview without consulting individual student performance</td>
<td>To decide when to move to the next learning objective at a class level</td>
</tr>
<tr>
<td>Identification of a student who is particularly struggling and the specific weakness</td>
<td>To speed up the time-consuming and stressful identification of struggling readers</td>
<td>To plan individualised support</td>
</tr>
<tr>
<td>Insights on how long struggling readers play</td>
<td>The intense work on fluency can impact students’ concentration and engagement</td>
<td>To identify lack of student concentration and engagement</td>
</tr>
<tr>
<td>Reports for ability groups</td>
<td>To know what are the strands within the class</td>
<td>To organise the group sessions better</td>
</tr>
<tr>
<td>Insights of the effects of the teaching methods used on students’ learning</td>
<td>To reflect on the learning design and methods used with students</td>
<td>Teaching self-assessment and planning of future activities</td>
</tr>
<tr>
<td>Impact of work on a particular learning objective on the others</td>
<td>To know the effects of previous learning design involving work on a learning objective on others</td>
<td>Teaching self-assessment</td>
</tr>
<tr>
<td>Struggling readers’ progress against themselves on a learning objective</td>
<td>To know about struggling readers’ strengths and learning achievements</td>
<td>To assess struggling readers’ strengths and improvements</td>
</tr>
<tr>
<td>Time spent to complete a familiar game</td>
<td>To re-challenge students on previous learning objectives they are confident with</td>
<td>To enhance students’ motivation and reinforce their learning</td>
</tr>
<tr>
<td>Time spent to complete a new game on a more advanced learning objective</td>
<td>To engage students individually or in competitions on future learning contents</td>
<td>To promote students’ engagement and assess their performance on new tasks</td>
</tr>
</tbody>
</table>
teachers strategically proposed activities for game play in which the data captured within LA would raise the visibility of achievements students had previously evidenced. Teachers envisioned the use of the NaviGo games at the end of the year, to re-challenge children on what they learnt in the previous months as well as a warm-up for September. One of the teachers proposed engaging students in competitions against themselves, or in pairs, on familiar learning tasks collecting data on the time they spent to finish a game.

Within the above examples teachers approached the LA as an end in itself. However, when discussing the potential of LA for struggling readers, the learning progress of a child was viewed as a meaningful contribution to the LA design process [23, 28, 29], such as limited data literacy, lack of data processing skills or the inherent difficulty in sense-making of visualizations. Conversely, in our study, despite our participants’ lack of experience with LA or other data-rich technologies, they were quick to understand how to use the Inspiration Cards and to imagine new scenarios. Thanks to specific methodological choices, in most cases teachers reached out for the cards and independently created their first scenario.

In line with Hornecker et al. [17], the gradual and scaffolded structure of the sessions in three phases outlined in Section 3.3. (group discussion on existing data practices, technology demo, card-generated inquiries), enabled the generation of new scenarios grounded on existing practices and ways of working. In our experience, without this process there may have been a temptation to address techno-centric questions based on data availability and everyone’s understanding of the features of the games. As noted by Ferguson et al. [10], considering end-users’ context from early stages can improve the chances for LA successful adoption.

Two workshop characteristics promoted participation. First, we reinforced the workshop structure with targeted support to each group of participants during the workshop. As explained in Section 3, each session included one researcher-participant with experience in design and one researcher-participant with understanding of LA. This mix of expertise allowed to scaffold the discussions towards creative but technologically feasible inquiries, which are now concretely informing system design. Second, the collaborative nature of the sessions allowed rich discussions that led to a shared creation of ideas, also thanks to the mixed composition of the three groups. For instance, the presence of headteachers as well as teaching assistants allowed to capture pedagogical as well as school and political perspectives within the same educational infrastructure.

5.2 Inspiration Cards

As discussed in the Background (see section 2.2), only recently the field has started to use cards as a co-design tool in workshops for early design stages (e.g. Prieto-Alvarez et al. [35] and Schmitz et al. [44]). As the body of knowledge around co-design tools for human-centred design is emerging [19], the following transferable reflections can support others who want to utilise Inspiration Cards or similar tools particularly in the early co-design stages with teachers or other non-technical stakeholders.

Our Inspiration Cards took the form of visual tangibles, thus providing participants with external representation of complex information as suggested by [39]. In contrast to the abstract and complicated nature of the algorithms underlying LA systems, we argue that the physicality and practical structure of the cards and tasks promoted understanding and subsequent active participation of non-technical practitioners. Furthermore, the simplicity of cards descriptions coupled with a visual representation on each card formed an artefact that provided a common basis for communication. However, we also noticed that possible ambiguities in cards interpretation were generative of rich discussions rather than a source of misunderstandings, also thanks to the participatory and open-ended nature of the sessions which allowed teachers to ask questions freely.

Cards played very specific roles in shaping conversations. For instance, in all workshops the Domain Cards helped teachers problematise learner-centred scenarios, and only later consider what role data can assume. More broadly, thanks to their semi-structured nature, the cards provided essential information without undermining creative thinking. This was reflected in a variety of scenarios in which LA tools play different roles. For instance, LA were considered as a means to enhance existing teaching methods (e.g. section 4.6) as well as opportunities to address children’s lack of strategic engagement in their learning when using digital technologies (section 4.1).

Our two categories of cards (Technology Cards and Domain Cards) allowed connecting unfamiliar data opportunities to different
aspects of learning design practices that are well-known and part of the everyday life of our participants, as suggested by previous research (e.g. [2, 38]). Within each category, we created a workable number of dimensions which, from our experience, allowed participants to understand and connect different domains easily. This positive insight confirms the importance of breaking down complex domains into smaller pieces based on clear logic structures when working in interdisciplinary teams [30]. Furthermore, as noticed throughout the process, our structure of cards categories and sub-categories, together with a lack of strict rules for their use, facilitated a creative combination of information and ideas that led to rich and diverse scenarios [39].

5.3 Trade-offs

By situating the design of LA in an already developed technology, the NaviGo games, possibilities for new alternatives were bounded by the design of the game activities and their domain. The specificity of cards scaffolded the construction of scenarios that were closely coupled with the NaviGo games. This close coupling meant that teachers exercised more control over the final design outcome.

Alongside these methodological strengths, however, the boundaries our process created may have invited particular perspectives, e.g., the invitation to think of enhancements to current teaching methods inherently represented within the cards. In fact, our participants rarely stepped back to question the assumptions embedded within the cards, nor did they create new cards. Similarly, teachers did not reflect on their own relationship with technology. This is in contrast to what was reported in Holstein’s et al. work with expert teachers [15]. For instance, all of our participants uncritically adopted a sense of trust that data would improve specific aspects of it. Our findings, therefore, suggest a possible trade-off connected to the use of Technology Cards. The same characteristics that promote teacher understanding of data opportunities, and participation and power in the design process, may also limit criticality. Future research should explore whether this relates to their experience with such technologies, and also identify ways to invite critical thinking.

6 Conclusion

Misrepresentation of teachers’ needs, desires and challenges in LA design can affect adoption (e.g. [11]). Co-design methods give voice to education stakeholders, and have the potential to involve them meaningfully in the design journey [34]. This paper provides a detailed case study describing a co-design approach to LA design in the context of an existing learning game. By reflecting on our methodological choices we provide transferable lessons for other LA researchers interested in employing co-design methodologies and tools such as the Inspiration Cards in line with a human-centred approach to LA design. Our contribution describes and reflects on the use of Inspiration Cards Workshops as a co-design methodology to involve teachers with low experience with LA tools in the early stage of the design process. Particularly, by showing strengths and trade-offs of using Inspiration Cards as a tool for co-designing learning analytics with teachers, we provide initial insights on its opportunities for generative LA design.

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