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Adoption and usage challenges of a Learning Analytics Dashboard for game-based learning: design and implementation implications

Andrea Gauthier, Manolis Mavrikis, Laura Benton, Mina Vasalou
UCL Knowledge Lab, Institute of Education, University College London
[andrea.gauthier, m.mavrikis, l.benton, a.vasalou]@ucl.ac.uk

ABSTRACT: We report challenges associated with the adoption and (mis)use of a teacher-facing learning analytics dashboard (LAD) created for data-informed decision-making in primary school literacy education. We developed a LAD to facilitate teachers' planning of game-based literacy learning activities, identification of children requiring additional support, and self-evaluation of teaching practices. Two teachers had access to the LAD over three months. However, it was not used as expected. One teacher did not access the LAD, whilst the other attempted to use the LAD for summative assessment purposes, rather than formatively, which raised issues for the interpretation of data. This paper makes a unique contribution to the LA community by reflecting on the implications of the challenges we faced in terms of the LAD's failed adoption and misuse for future LAD design and implementation in the classroom.

Keywords: learning analytics dashboard, game-based learning, implementation challenges

1   INTRODUCTION

With increased use of learning technologies in the classroom, comes opportunities to utilise learning analytics (LA) to drive pedagogical change and improve children's learning in a formative manner (Kovanovic et al., 2021). *Navigo* is an adaptive, tablet-based game designed to reinforce literacy learning in primary schools across a range of language categories, e.g., phonics, prefixes/suffixes, grammar. It has 16 mini-game mechanics and 900+ game activities that produce LA on what, when, and how well the children played. Co-design workshops with teachers generated pedagogical aims and initial design concepts for how LA might support data-informed decision-making in literacy teaching through *Navigo* using a LA Dashboard (LAD) (Vezzoli et al., 2020). The LAD design (Figure 1 and https://tinyurl.com/NavigoLAD) catered to five aims: (1) plan learning activities for common gaps in class, using the bar chart identifying "top areas that need work"; (2) decide when to move to next learning objective at a class level, using the line chart; (3) identify lack of student engagement, using the line graph charting progress over time; (4) assess students' strengths and weaknesses and plan individualized support, using the filtered view by student and the tree map; and (5) self-assess teaching practices, by combining information from all views. However, because education often places an emphasis on summative evaluation and less on formative assessment (Shute, 2008), teachers may not necessarily approach a LAD with a formative, decision-making mindset, which could limit the capacity of our LAD to be used as a feedback loop and contribute toward continual development.

2   CASE STUDY METHODOLOGY

We implemented the LAD in one school in England with two teachers who were using *Navigo*. Both teachers taught literacy to children aged 6-7 and used *Navigo* weekly for about 30 minutes. They also

assigned *Navigo* activities for children to play at home during the COVID-19 lockdown. Whilst the LAD was only accessible from March-May 2021 (three months total), it displayed analytics collected for *Navigo*'s entire use period (Nov 2020 - May 2021). One teacher, T1, had a special interest in using data for learning and a data analytics background, whilst T2, was a more experienced teacher and very data-literate. T2 was also involved in the LAD's online design workshops. Prior to the LAD's implementation, we held an online teacher training session to show the different LAD functionalities. We purposefully took a hands-off approach to the implementation of the LAD in the classroom, allowing the teachers to use it as they would outside of a research context, apart from a few emails to check if there were any problems and respond to any teacher enquiries. The case study involved log data collection of when/how long the teachers used the LAD, as well as 1:1 interviews in June 2021. As a secondary data source, we include emails from T1 to the researchers and an online discussion (prior to the final interview), which informed us about their initial encounters with the LAD.
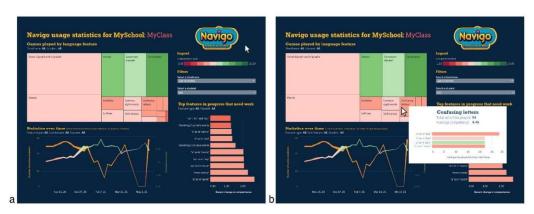

Figure 1. (a) *Navigo* **LAD displaying language feature frequency and performance, which can be filtered by time, individual student, and category. (b) Hovering shows additional information.**

3   CASE STUDY RESULTS

<u>Logged LAD usage</u>. There was **limited use of the LAD**. T1, used it four times during May 2021, for an average of 6.31 (SD=5.76) minutes per session, totaling 25.23 minutes. T2, did not use the LAD at all during the three-month trial. As such, our findings are largely based on T1's data.

<u>Contact point – email communication</u>. An email from T1 revealed that she **approached the LAD through a lens of summative assessment** because she had been asked by her Deputy Headteacher to provide any data or summary of literacy improvements of students using *Navigo*. This was an unexpected use of the LAD that deviated from the intended formative aims. Based on this request, T1 used the LAD to look for "significance", to summatively assess how children were performing and report back. During this process, T1 emailed the researchers to discuss her interpretations about her class's literacy performance in *Navigo*: "If I look at the 'competence level' parameter, am I right in thinking it is a way to assess their improvement? […] I would have imagined that the best way to get significance is over the class as a whole and on the 1st term when children were in lockdown [Nov-Feb] and used it the most. The average competence level on Jan 10th was 7.7 and it went up to 8.65 on Feb 21st before going down along with the amount of usage as the children came out of lockdown." T1 was trying to draw summative conclusions based on the line graph in an *unfiltered* state, that visualized data from all language categories, which, as discussed below, might mislead summative

assessment. This email highlighted that **teachers' interpretation of visualizations should be further scaffolded**, e.g., by training *throughout* its implementation, for it to be used well formatively.

<u>**Contact point – online discussion**</u>. Following this email, we held an online discussion with T1 to review how she might use the LAD toward summative evaluation of children's literacy skills and fulfill the Deputy Headteacher's request. By screen-sharing the LAD, we jointly reflected on the challenges in interpreting "significant" improvement over time based on competence levels in the unfiltered line graph. By exploring the data, we identified that the recent drop in competence (identified in T1's email) may have been due to children tackling new, more difficult content, e.g., adverbs & adjectives, as opposed to easier features that were played during lockdown. We pointed out that it would be **inaccurate to take a snapshot of data from all language features over time**, as features were tackled at different times of the year and with increasing difficulty. As such, with T1's recent introduction of adverbs/adjectives in the classroom, children's competence appeared to plummet, but easier features (mastered but not played recently) were not factored into the visualization for that time point in the line graph. Contrastingly, by filtering for single language features that were practiced consistently over several months, we could see "truer" trends in how competence changed during lockdown, which could use as summatively. This discussion helped T1 understand that, **to use the LAD *summatively*, she would need to consistently assign the same language feature over a longitudinal period**, so that competency changes could be tracked with enough data. She suggested that she would try this going forward. We then reintroduced how T1 might use the LAD visualizations *formatively*, to better students as they progress in their learning. However, whilst this prospect excited her, T1 noted that time in class was a major limiting factor: **she did not have time to use the LAD in a formative way**.

<u>**Interviews**</u>. T1 reflected that our online discussion did not change how she approached the LAD, used *Navigo*, or taught literacy in the classroom, but reflected that not changing her approach proved disadvantageous for summative evaluation: "We continued looking at the games, changing the games regularly. Which meant that when we were looking at the results [in the LAD] and trying to see if we could pull out any positive data about the use of *Navigo*, we couldn't necessarily because every time I introduced something [new] it was gonna be hard. […] If I want to use *Navigo* to have data at the end of the year and show improvement, then […] I would assign some games and leave the games the same across the whole year, or across a long a period of time." T1 then reflected that she wished she had had earlier **discussions with the researchers about types of strategies** she could have used to ensure the game data and LAD visualisations could have been used for summative assessment, saying "well, I guess I didn't discuss maybe as much as I should […] I didn't discuss very much with you the different kind of strategies of how you can use *Navigo*". Yet, T1 saw how the LAD could be useful to inform her teaching practices, indicating even though she did not use the LAD formatively, it could have had potential to facilitate self-evaluation of her teaching practices and plan future learning activities: "[…] I still want to see how they're doing because if they're not doing well with adverbs and we've been talking of adverbs that means I haven't done a good enough job, or they haven't understood the game. So, we need to talk about it and maybe do another lesson. […] It will be an informative tool to decide what lessons I should do." Despite two email prompts about the LAD from the research team, T2 expressed in her interview that she forgot about using it. She went on to say that "I'm quite data-driven so I would find [the LAD] incredibly useful". Yet, like T1, she also expressed the lack of time in the classroom for this type of data exploration, and that it was difficult enough to find time for the game-based learning activities in the first place, let alone the LAD.

4   IMPLICATIONS FOR LAD DESIGN & IMPLEMENTATION

Our communications with T1 highlighted the issue of **approaching the LAD – which was designed for formative processes – through a summative evaluation lens,** in part due to the focus on summative assessments in schools (Beck & Nunnaley, 2021). The *Navigo* game breadth with 900+ activities combined with limited classroom time meant that children's gameplay was spread out. Thus, there was not enough data on any one language category to make concrete summative evaluations. When the unfiltered data was visualized on the LAD it created a biased and misleading visual representation of students' performance, based on how teachers selected new activities (Pelanek, 2021). Whilst we demonstrated a priori how the LAD was designed to be used for formative processes, we should have (in hindsight) explicitly discussed with teachers how a game with broad content, like *Navigo*, could also be used for summative evaluation, e.g., by limiting content assigned to children. LAD designers might also remove unfiltered data view in the line chart, so that misinterpretations cannot be made.

We also identified that **teachers need specific and contextual experience and practice with LADs to understand how to interpret visualisations and approach them with a formative mindset.** This implies that, in addition to pre-training, LAD providers should provide training over several months during use, to allow teachers to practice and build their skills in between training sessions. LAD designers might also build scaffolds directly into the LAD to guide teachers' formative interpretation of visualisations. For instance, **a LAD might incorporate alerts or advice to facilitate teachers' formative appraisal of data and act upon insights in the classroom**. Previous research has compared LADs which (i) mirror students' interactions and performance, (ii) alert teachers to data that need attention, or (iii) advise teachers about what actions to take next in the classroom (e.g., van Leeuwen et al., 2019). Such studies provide evidence that alerting and advising approaches might help teachers better interpret learning situations during 'live' classroom activities. Whilst we used color-coding to alert teachers to problematic concepts needing to be addressed, integrating *specific advice* on how to deal with these issues might have reduced T1's cognitive load and encouraged its more regular and formative use. In summary, despite interest and involvement in the design of the LAD and high data literacy, the teachers did not have time or skill capacity to use the LAD in meaningful, formative ways.

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