Title: Reflections on personalised games-based learning: how automation is shaped within everyday school practices

Digital games for primary education are often designed to foster children's learning through motivated practice with core subjects, such as literacy and maths. Over the years, and accelerated by the pandemic, these games have become an embedded part of the primary school classroom. Many of them rely on AI and thus *automation* to adapt children's learning game tasks and personalise the learning to the child's learning needs. While removing the requirement for the teacher to plan what students do with the technology, children's engagement with digital learning tasks, and the digital reports generated as a result, have also been proposed to be a critical way to help teachers deliver targeted and time efficient teaching interventions to those who need them the most (du Boulay, 2019; Mavrikis and Holmes, 2019).

The design intensions of personalised games-based learning (PGBL), and more broadly AI-enabled learning technology, have been underpinned by a programme of research couched in the learning sciences. Many researchers have been concerned with the learning gains of PGBL as compared to teacher-led interventions seeking to show that PGBL is superior (e.g. Tocak et al, 2016; Vanbecelaere et al, 2020; Serra and Gilabert, 2021). Other research has focused on the teaching environment and on teachers. Teachers' digital competencies, mistrust in AI, or the clash between AI and curriculum-driven teaching have been identified as reasons to why teachers struggle to take up the opportunities of automation, for example by disabling the PGBL from acting autonomously (e.g., Ritter et al, 2016; Pflaumer et al, 2021). The assumption that this technology can contribute to more effective learning and teaching has also featured prominently in policy discourse (e.g., Council for Science and Technology and Government Office for Science, 2020; Department for Education, 2019).

Yet, the idea that automation in education is a paradigm shift toward the better has been increasingly challenged within the social sciences (e.g., Selwyn et al, 2021). Researchers conducting situated research in schools have convincingly shown that schools are complex spaces and new apps, such as PGBL, sit within and interact with pre-existing learning ecologies, infrastructures and human networks that shape how PGBL is ultimately used and its emergent benefits (Ibrahim et al 2022; Pangrazio et al 2022; Mayer, 2015). Elsewhere, it has been argued that AI-enabled technology and the essentialist logic underpinning the imagined benefits of automation tends to be disconnected from practice and the messiness of everyday life that shapes how technologies are appropriated (Strengers, 2014). This perspective serves as an anchor point in this short piece. Our aim is to show three ways in which PGBL, its automation and the resultant benefits are shaped by socio-material entanglements. Existing research into PBL, has often narrowed its focus on the technology and the teacher. By widening the lens of the empirical inquiry, we wish to show the range of mundane factors that contribute to the role automation plays in the primary school classroom. To substantiate this, we draw examples from field research documenting the use of a bespoke personalised literacy game called Navigo.

Navigo – a field study

Designed within an EU-funded Innovation Project, Navigo is an adaptive literacy game covering Key Stage 1 and 2 reading curricula. The game contains more than 900 mini literacy games whose selection is driven by an adaptive mechanism personalising the game content based on the child's ongoing performance (Benton et al., 2021). Alongside the adaptive mechanism, there is a teacher tool that enables the teacher to override the game's automation. Although the teacher tool was requested by teachers in an initial co-design phase, we note that the feature was used in only 20% of children's game sessions and thus the majority of game play was directed by the adaptive component.

To design Navigo, we drew upon theories of learning and teaching to scaffold children's learning, e.g., through providing clear game objectives, success criteria, instructional feedback (Benton et al., 2018; Benton et al., 2021). Nonetheless, across several empirical studies on children's literacy game play (including with Navigo) we showed that children across the primary school age range could not use these instructional features in their learning independently (Benton et al., 2019; Vasalou et al., 2022; Gauthier et al., 2022). In this respect, our research cast doubt on the claim that PBGL improve learning outcomes without the presence of an adult to scaffold game play from the outside (also McTigue at al., 2020).

Following Navigo's design, over a period of 2.5 years, we supported and observed teachers in eleven schools within the South of England who used Navigo in their mainstream classes and in specialist sessions with children struggling to read. 600 children used Navigo. During our field visits to the schools, we kept field notes to document observations/conversations with the teaching staff and additionally, we conducted two interviews with each participating teacher early in the research and at the end. This data was analysed inductively, and the socio-material relations emerged from the analysis. In this short paper, we present three school vignettes that communicate the key themes identified.

Vignettes

The *Harwell school* intends to use Navigo with four classes. With a set of 30 tablets to be shared they choose a central location to store and charge the tablets. However, this location is not accessible to the class teachers as it is located far away from the classrooms. Upon reflection, one of the teachers proposes that each teacher takes 7-8 tablets to be stored, charged, and accessed in class. This decision impacts on how Navigo is used i.e., in rotating small groups during daily carousel activities ensuring each child can play once a week. Having come to rely on the adaptive functionality of Navigo during this intense set up period, the teachers appreciate the time Navigo affords them to look after the rest of the class. Thus, children playing Navigo continue to do this independently without teacher support.

At *Eudora school,* Marie notices that her Year 2 children (aged 6-7) have persistent problems with Navigo. Some cannot log into the game with their credentials. Others spend too much time on their avatar. Quite a few children repeatedly tap when the game is in progress in the log in screen, and this introduces crashes that Marie must mitigate. While Marie initially intended to spend time planning to align Navigo with her weekly teaching through the teacher tool, she continues to rely on the adaptive functionality of Navigo. This gives her the time to

develop strategies that address these other challenges, e.g., teaching her students digital literacy skills on how to log in.

At the *Manor school*, Clare struggles to find a time slot for Navigo in her packed timetable. While she appreciates Navigo's fit with her curriculum and recognises her students' enthusiasm when playing the game, the game competes with other 'more legitimate' and tested activities. This contributes to using the game once a week with her class. Owing to the little time available, and the wide breadth of games in Navigo, children do not play enough games to unlock more advanced areas of the game. Thus, seeing that the content does not change, Clare talks about Navigo as an intervention that consolidates her students' past learning.

Reflections and Discussion

The findings from our field study highlight several points that speak to how PGBL and the automation that underpins them is often discussed in the context of education.

First, alongside other AI-enabled learning technologies, PGBL have been proposed to save time for the teacher and contribute to more effective teaching/learning (du Boulay, 2019). In contrast to this perspective, we found that the use of this technology created new mundane tasks in the classroom that needed to be taken care for. In the case of Navigo, teachers needed to manage young children's lack of experience with the logging in or had to devise new ways to care for Navigo's tablet before the game could be even used. Thus, as opposed to contributing to more effective teaching interventions, our findings highlighted that Navigo's automation played a 'functional' role, freeing up teacher time to attend to these new tasks. We argue, that for aspirations of PGBL to transpire, schools and their teaching staff must first identify and plan effective ways to overcome some of the mundane tasks and related workload introduced when bringing technologies into the primary school classroom.

Second, automation highlighted a problematic tension between playing independently and learning independently. This was expressed in the Harwell vignette where Navigo was used to keep a small group of children occupied, whilst the rest of the class were supported by the teacher to engage in 'analogue' learning activities. The automation embedded in games, and Navigo's game design, allowed children to continue playing through the digital game activities without disruption. This provided teachers with reassurance that children were learning independently. However, challenging this approach, past research has shown that the teacher's external supportive role alongside PGBL predicts primary school children's learning (McTigue et al., 2020). Our findings reemphasise ongoing calls to develop new pedagogical approaches for supporting children when using PGBL and also highlight the equally important need to mitigate the perception that PGBL engenders independent learning.

Finally, in our field study, teachers restricted the time they spent with Navigo in their literacy classroom, with this shaping how Navigo's automation 'worked' and in turn how the benefits of Navigo were perceived. All participating teachers acknowledged their students' motivation

and the value of Navigo's content. However, as the Manor vignette illustrates, attributing 'effectiveness' to Navigo was also raised as a challenge by the teachers since the game was one of several literacy activities in which children engaged. This led some teachers to limit children's game play to once a week ensuring children were immersed in 'tried and tested' methods, alongside more experimental literacy opportunities such as Navigo. Navigo was also afforded less time due to the additional requirements introduced by the game and its tablet (see vignettes 1 & 2), e.g., contributing to groups of children playing Navigo on a rota once a week. To progress in the game, master reading features and unlock new ones, the game required children's constant engagement over time. Although Navigo's content was initially synchronised with the class curriculum, over time children's classroom literacy learning moved faster than the game content they encountered. Thus, the inadequate time afforded to the game limited the operation of automation and the game's ability to support personalised learning. Teachers in turn began to perceive Navigo as a catch up/consolidating of past learning, even though the game incorporated a much wider breadth of content their students had not yet encountered. PGBL, and other AI-enabled learning technologies, are often discussed as paradigm changers that will support children's learning through their personalised approach. We find that a range of factors – such as teachers' accountabilities toward children's learning, or tablet resource management concerns – can introduce time constraints that impact upon how automation works and consequently redress how PGBL is perceived in the classroom. Taking a situated, socio-material lens can highlight how PGBL is used in everyday schooling, provide a critical perspective on the hypes concerning this technology, and expose the diverse factors that mediate how this technology is appropriated suggesting a range of nuanced mitigations.

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