Extended Abstract for the
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DATA AND AI LITERACY …WITH CREATIVITY AND FUN!

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Overview

The Data Education in Schools project (https://dataschools.education) has been running in south-east Scotland since 2018. The project aims to educate young people aged 3-18 years old about data literacy and data science to enable them to thrive as citizens in a data-driven society (Robertson and Tisdall, 2019). To achieve this, the project runs professional learning for Primary and Secondary teachers organised in knowledge creating communities (Robertson et al, 2023). In addition, the project team has developed teaching resources and activities for this wide range of learners.

The teaching and learning materials for learners aged from 16 years old are focused on data science topics and skills (Data Education in Schools, 2019), and primarily support the national qualification in data science which is available to students in senior secondary and further education college (Farrell et al, 2023a; Farrell et al, 2023b).

The focus for younger learners, ages 3-16, is on introducing them to data literacy concepts in an interdisciplinary way through creative and fun challenges that use authentic problem-solving contexts for learning, utilising real-world data (Farrell & Robertson, 2019). The activities integrate curricular outcomes from mathematics, social subjects, computing science and sciences, as well as creative arts and literacy, utilising techniques such as data physicalisation and gamification. Through these playful and fun activities, the project has reached hundreds of schools and tens of thousands of learners (Data Skills Gateway, 2024).

Interdisciplinary Data Literacy

School learners increasingly need data literacy skills in order to make sense of a data-rich world. The Data Education in Schools team have used the definition proposed by Wolff et al (2016) where data literacy is "the ability to ask and answer real-world questions from large and small datasets through an inquiry process, with consideration of ethical use of data. It is based on core practical and creative skills. …These include the abilities to select, clean, analyse, visualise, critique and interpret data, as well as to communicate stories from data and to use data as part of a design process."

Early in the project, the team identified the difficulties of the stresses placed on teachers regarding the crowded curriculum and the time pressures placed on them (Hulme et al, 2024). The project took the approach of identifying outcomes related to data literacy already present in the national curriculum and designing interdisciplinary activities that would appeal to teachers of subject specialisms other than just Computing Science, recognizing the cross-curricular nature of data science. When introducing data literacy concepts to Primary teachers, they quickly could see the relevance to the lessons they currently deliver, such as one teacher who told the team "Oh we do that! But that's just the gardening club" (Robertson and Farrell, 2023).

Gamification of Data and AI Literacy

One approach when developing activities was using gamification to foster engagement, motivation and provide a fun and entertaining experience while teaching numeracy skills. In one set of activities, tasks of interpreting graphs and tables of data were enhanced by adopting an 'escape room' style of activity (with an artificial emergency situation and timescale) and a storyline involving the young people becoming 'Agents of DATA' and attempting to save the country from the high-tech 'VIKINGS' villains by using their skills in data literacy and graph interpretation (Data Education in Schools, 2024). These activities, based on successful gamification techniques including timed activities, collaboration and narrative (Huang et. Al, 2020), have been run in person with hundreds of school learners, and online in a 'live lesson' format with thousands of learners watching concurrently while doing the activities in their classrooms. Like with 'unplugged computing' activities (Battal et al., 2023),

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data literacy does not require learners to use computers. The core concepts can be taught without using technology, and certainly without using spreadsheets or analytical software.

The Agents of DATA activities have been designed to be 'no-tech', only requiring a document to be downloaded or printed so that teachers could adopt them easily without requiring special equipment like specific types of padlocks that are common with educational escape rooms. One activity ('Locked in the DATA Base') has a 'low-tech' option, where learners have a choice of entering their answers into a webpage 'alarm system' or using a paper worksheet (Data Education in Schools, 2023a).

All of the Agents of DATA activities (or 'missions') were designed to involve analysing, interpreting or visualising data in some way. The 'Locked in the DATA Base' activity asks learners to interpret tables of data and data visualisations on rollercoasters and theme parks in order so solve a set of questions. When the answers to all the questions are added up, it should give them the secret alarm code to unlock the door. The 'Find the Secret Lair' mission (Data Education in Schools, 2023b) involves learners taking information and representing it in a different format. In this activity they are presented with a series of datasets (real data on locations of underground bunkers, wind farms, data centres and undersea fibre cables) which need to be plotted on a map of Scotland to narrow down the possible locations of the VIKINGS' secret lair. Throughout the activity, as well as using these location datasets, learners find out about data security, internet infrastructure and how to use the National Grid reference system (Ordinance Survey, 2016).

The activities have been popular with teachers, who have run them as events for a whole year group, including teachers and student facilitators dressing up as secret agents to run the missions. Teachers have also created their own local versions of the activities, such as the North Lanarkshire Digital School team who recreated the 'Locked in the DATA Base' activity with datasets of local towns instead of rollercoasters. As part of a group project module, a team of undergraduate Computing Science students from Edinburgh's Napier University created an online escape room game featuring the Agents of DATA characters, with a series of puzzles on data interpretation (Donnelly et al, 2023).

The Data Education in Schools project has also used gamification strategies in a series of online 'live lessons' developed with Digital Skills Education (2024a), where learners carry out an activity on their classroom devices while watching a live YouTube video broadcast with hosts explaining the task and providing advice, encouragement and additional background. The 'Defend the Rhino' activity involved hundreds of learners working together to train and use a machine learning model to recognize humans in security camera images and stop a poacher (Digital Skills Education, 2021). This activity was staged, with the next task in the activity being released to match the narrative and pace on the live YouTube video. For example, in the first stage learners are manually checking images to identify images containing poachers, with a counter displaying how many images have still to be checked (and occasional 'encouraging' messages like "Keep scrolling! Only 15,999,860 images to go!") Once the organisers were confident that all schools involved had enough time to login and overcome any technical issues, the next phase of the activity was released, where the learners carry out supervised machine learning, training a model with images containing humans. The escape room style pace is kept up through the enthusiastic presenters and in-game messages like "We don't have much time until the poachers are due to attack!"

Like the Agents of DATA activities, these live lessons have a sense of urgency with the video hosts encouraging the learners on through the tasks, and a sense of fun, with learners practicing data literacy skills through studying tables of data on Zebra Flu patients in 'Unmasking Data Disasters' (Digital Skills Education, 2023a) or interpreting graphs to improve the performance of F1 race cars in time for the start of the race in 'Numbers in the Fast Lane' (Digital Skills Education, 2023b)

Understanding AI

Since 2023, members of the Data Education in Schools team have been using the strategies that have been successful for data literacy education to develop activities to educate young people about artificial intelligence (AI) and exploring ethical issues with AI systems. Live lessons and gamification techniques were used to develop an AI gameshow called 'Unbelievably Talented' (Digital Skills Education, 2024b). The young people in the gameshow audience decide the most talented creator in different rounds of the talent show, with submissions from artists, costume designers, chefs and

comedians. After choosing their favourite submission in each round, the young people then attempt to spot the creative artifact that has been produced with the aid of generative AI tools.

In November 2024, the Data Education in Schools team took on a team of Secondary teachers as 'Responsible AI' Teachers in Residence to develop additional subject-specific activities and provide professional learning across Scotland in 2025. These will be available online with a Creative Commons license from June 2025.

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