## Inclusive Data Literacy for BVI Students

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## Abstract

Data literacy - defined as the ability to articulate information needs, retrieve, evaluate, and manage data [3] is an essential skill, projected to be paramount by 2030 [1]. However, blind and visually impaired (BVI) students face significant barriers to developing data literacy due to the reliance on visual learning materials. This paper proposes an innovative methodology that integrates Universal Design for Learning (UDL), Data Storytelling (DS), and Generative AI (GenAI) to transform traditional data education into accessible, narrative-based, and multimodal experiences tailored to individual BVI learners.

UDL, based on the *Design for All* philosophy of the European Institute for Design and Disability [4], is a student-centred framework that promotes inclusive education by offering multiple means of representation, action, and engagement, thus accommodating diverse learning needs through digital technologies [7, 8, 6]. DS offers an inclusive alternative to traditional data education [11] by combining narrative with auditory and tactile modalities [10], allowing BVI students to access and interpret complex information through multisensory experiences. Enhanced by GenAI, DS can be personalised in complexity and format, using well-established narrative structures—such as the three-act structure [9], Freytag's Pyramid [13], and the Hero's Journey [12] to improve comprehension, retention, and engagement while reducing educator workload.

The proposed methodology, grounded in both pedagogical theory and practical expertise in inclusive education, enables teachers to customise standard educational content by incorporating three key elements: the General Education Programme (GEP), the student's Individualised Education Plan (IEP), and Available Assistive and Educational Technologies (AAET). UDL personalises content and methods for individual learning requirements, DS transforms material into engaging narrative-based lessons that enhance data literacy, while GenAI combines GEP, IEP, and AAET to create a personalised educational programme, as well as multisensory and narrative-based learning experiences that address the specific needs of each BVI student while promoting inclusion and accessibility. In addition, GenAI recommends suitable assistive technologies to improve accessibility and personalised learning experiences. To test the feasibility of the proposed methodology, we performed two preliminary experiments using ChatGPT versions 4.0 and 4.5, providing each with contextual documents, including a primary school data literacy programme, a BVI student's IEP and a list of assistive technologies. The case study focused on a blind 6-year-old girl and aimed to create narrative-based adapted lessons on classifying animals by attributes such as colour and diet, using multisensory tools such as a screen reader, clay, and tactile boards. The GenAI models were prompted to generate a three-act data-driven story tailored to the student's needs. All context documents and results are available on GitHub [2].

The story generation outcomes varied between the ChatGPT models: version 4.0 produced more sensory-rich exploratory lessons, while version 4.5 created structured, digitally driven data stories aligned with the three-act format, proving more effective and suitable for classroom use. Both versions supported inclusive teaching, demonstrating how combining UDL with AI-assisted data storytelling can personalise learning for BVI students without isolating them, enhancing critical thinking, and promoting independence. Field testing is planned for summer 2025 in collaboration with the Italian Association of BVI [5] to evaluate the effectiveness of DS in improving data literacy. A comparative study will involve two groups of K-12 students: a group will follow a traditional path without using DS. The other group will engage with the AI-assisted DS approach. Both groups will complete pre- and post-programme questionnaires to assess outcomes and measure any improvements in data literacy. If field validation progresses positively, the proposed approach could become a replicable methodology for accessible AI-enhanced data literacy education in other contexts.

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