

Empowering Teachers to Foster Data Science Literacy for Civic Engagement and Social Justice: Design – Based Approach

Georgia Solomonidou (ge.solomonidou@external.euc.ac.cy) * 1 Cyprus

Yianna Danidou (y.danidou@euc.ac.cy) * 2 Cyprus

Maria Meletiou-Mavrotheris (M.Mavrotheris@euc.ac.cy) * 3 Cyprus

Efi Paparistodemou (e.paparistodemou@cytanet.com.cy) * 4 Cyprus

*1 European University Cyprus, Nicosia, 1516, Cyprus

2 Department of Computer Science and Engineering, European University Cyprus, Nicosia, 1516, Cyprus

3 Department of Education Sciences, European University Cyprus, Nicosia, 1516, Cyprus

4 Cyprus Pedagogical Institute, Nicosia, 1434, Cyprus

INTRODUCTION & AIM

CIVIC ENGAGEMENT

In today's datafied world, the ability to critically interpret, analyze, and act on data is essential for civic participation and informed decision-making (Wing, 2019). However, data science literacy—recognized as both a scientific skill and a civic competency—remains underdeveloped in many school systems.

The Erasmus+ project *Data Science Education in STEAM for Civic Engagement and Social Justice from the Early Years (DataScEd4CiEn)* (2023–2026) addresses this challenge by embedding data science into STEAM education for students aged 9–15. Coordinated by the European University Cyprus and funded by the Cyprus Foundation for the Management of European Lifelong Learning Programmes (IDEP), the project brings together partners from Cyprus, Greece, Ireland, Germany, and Spain to develop an innovative framework for integrating data science into STEAM curricula. In this poster, only the case of Cyprus is showcased.

The project explicitly encompasses and addresses the cross-cutting priorities of digital transformation and democracy education at the European level. *DataScEd4CiEn* was informed by recent calls to integrate data science into school curricula from an early age. This work draws on the emerging field of data science education as an interdisciplinary approach for investigating problems through the analysis of large-scale, non-standard, heterogeneous, and/or complex datasets, an approach also supported and empirically examined by Makar, Fry, and English (2023).

In the aforementioned study, primary school students were observed to assume roles as agents and advocates of change while developing active citizenship competencies through engagement with data science. The same recent study further demonstrated that complex data investigations within citizenship education are feasible at the primary level when supported through meaningful curriculum integration.

METHOD

A central component of the project was a modular, Blended Professional Development (BPD) approach designed to empower primary and secondary teachers to collaboratively design and implement data-rich STEAM learning scenarios addressing civic issues such as environmental justice, equity, and socio-economic challenges. Grounded in situated learning and a Communities of Practice approach, the BPD program combines interactive workshops, case-based discussions, collaborative design activities, and hands-on exploration of digital tools such as CODAP, Gampinder, and Teachable Machine.

Using a Design-Based Research (DBR) methodology, the project followed an iterative process involving two rounds of implementation and refinement of the PD program. Data from the first pilot implementation in Cyprus were collected through surveys, focus groups, teacher reflections, and classroom observations and analyzed to inform revisions to the course structure, content, and pedagogical strategies before the second implementation. This iterative process allowed the research team to refine the program based on classroom experiences and teacher feedback.

Across both phases of implementation, students engaged with authentic datasets, formulated investigable questions, analyzed emergent patterns, examined ethical and civic dimensions, and developed informed responses to issues pertaining to sustainability, responsibility, and social justice. These experiences underscore the capacity of data-intensive STEAM activities to transcend conventional disciplinary boundaries and to reinforce the connection between classroom learning and civic engagement.

Phase 1 took place at The English School of Nicosia, Cyprus in November 2024 with 46 teachers in total, for building foundational understanding of STEAM, Data Literacy and Civic Inquiry.

Phase 2, continued with the same school in February 2025, as an intensive training with core group of 11 teachers, engaging deeper into data tools, AI concepts and lesson co-design.

RESULTS & DISCUSSION

Commencing the two phases mentioned in the methodology section, a collaborative planning phase with Departmental coordinators in Cyprus, finetuned 1 of 12 interdisciplinary scenarios to be found within *DataScEd4CiEn* project entitled 'What is the True Cost of My Clothes?'. This newly developed 'Fast Fashion' Unit was taught in two Year 8 classes over March – May 2026. The goal of this scenario was to examine the Social and Environmental impacts of 'Fast Fashion' with the learning objectives of building students' ethical awareness about consumer behavior, applying data science reasoning to real-world data, and analyzing how the fashion industry affects people and planet.

The scenario was co-taught across multiple subjects, each contributing a unique lens. For example: PSHCE covered ethical and global citizenship aspects (consumer ethics, labor practices) Mathematics focused on data analysis of fashion industry statistics, Science addressed environmental impacts (e.g. waste, pollution), English guided narrative and reflective writing on fast fashion, Art/Design & Technology challenged students in creating upcycled fashion items, Computer Science component supported technical tasks (like making a website or an AI-generated video as part of the project).

Students engaged with authentic datasets about the fashion industry. They used CODAP (an online data analysis platform) to visualize and analyze data on clothing production, waste, etc. Crucially, students weren't just passive – they formulated their own research questions (e.g., "How much water is used to make a T-shirt?" or "What happens to clothes we throw away?") and investigated the data to find answers.

This inquiry-driven approach gave students agency. For instance, as a hands-on component, students designed and prototyped upcycled clothing products (turning old clothes into new items) to demonstrate solutions for sustainability, directly linking their data findings to action. Students wrote reflective essays on their learning about fast fashion and consumer responsibility; they gave peer presentations sharing their data insights and ethical arguments. They showcased their creative products (upcycled designs) in an exhibition event. Outcomes were presented not only to peers but also in front of the Senior Leadership Team (SLT), emphasizing the civic and institutional value of their work.

This combination of written, oral, and project-based assessment captured both their understanding of data and their ability to apply it in a civic context.

After the Phase 1 workshop, the majority of teachers found the PD useful to their teaching:

- 60.9% agreed it was directly relevant to their everyday practice
- 84.8% said the session helped them clearly understand the project's aims and content

Among the 11 core teachers who implemented Phase 2, about 73% (8 out of 11) felt that an extended training would be helpful in planning their teaching moving forward.

- The PD influenced mindsets: 8 of 11 teachers said their perspective on teaching data science had changed due to the program
- 7 of 11 reported a similar shift in how they view teaching for civic engagement and social justice. This indicates many participants experienced a genuine pedagogical shift.

Since the implementation of the scenario there was marked increase in STEAM awareness and buy-in. Initially, 43.5% of the broader teacher group didn't know much about STEAM. After the PD (among the core team), 72.7% (8/11) indicated their perspective on STEAM teaching had evolved and improved. So, those who were actively involved in the pilot went from unfamiliarity to really embracing STEAM approaches.

Qualitative evidence showed teachers translating the PD into action. They moved from having limited experience with data/STEAM to confidently co-creating and teaching a full interdisciplinary data-driven project. The success of the Fast Fashion scenario exemplified this growth – teachers demonstrated improved data literacy and collaboration skills by facilitating complex, real-world lessons that would have been unlikely before. In short, their TPACK (technological, pedagogical, and content knowledge) for integrating data science in STEAM was noticeably enhanced.

CONCLUSION

Early findings indicate improved teacher confidence and capacity to foster students' data science literacy, ethical reasoning, and civic awareness through interdisciplinary STEAM learning.

The PD was very positively received – teachers felt it was "eye-opening" and empowering. At the same time, their feedback suggests some improvements for future iterations:

- providing extended workshops or follow-ups for continued skill-building
- structuring the PD schedule to allow deeper collaborative planning time.
- Targeted PD focusing on data science in a real-world, civic context can significantly boost teachers' confidence and capability to teach in new interdisciplinary ways.

REFERENCES

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