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DIGITAL EDUCATION ECOSYSTEMS AND SEAMLESS INTEGRATION: PREREQUISITES, OBJECTIVES, AND REALITY.

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ABSTRACT | Digital transformation is anticipated to have a major influence on a global scale. The use of digital technology in education and its integration has become a national priority for many countries, with leaders in education and policymakers targeting institutions to become operationally efficient and act promptly to implement changes deemed to enable digital innovation. However, it appears that the digital transformation in education is part of a more complex and intricate system. A lack of clarity, requirements, and well-defined objectives necessitate the active collaboration of all relevant stakeholders and decision-makers across sectors to co-create and lay a strong basis for the development of a systemic approach to address this pressing issue. This calls for solutions capable of proactively navigating this renovation, ensuring that ongoing assessment, flexible thinking systems, and analysis of the long-term implications for the claimed shift align with pedagogical goals, enhance student engagement, and ultimately improve learning outcomes. This short paper must be seen as a conversation starter that aims to clarify the urgency of digital transformation for public education and pinpoint the critical components that hinder effective digital transformational change. By following a holistic approach to targeting systemic change, the scope of future research is to identify the trajectory of technology policy for education within the digital educational landscape and possibly address the present and recent history to set the groundwork for an analysis of feasible and successful digital service design solutions that meet the set objectives.

1. Introduction

Fostering the development of a high-performing digital education ecosystem and enhancing digital skills and competencies has become a key priority around Europe. This short paper is intended to clarify, initially, the urgency and meaning of digital transformation in public education. It will then focus on selected challenges faced by all stakeholders involved in the educational ecosystem and how they are currently addressing those challenges while also highlighting some of the conditions that can make those initiatives feasible. Finally, it will suggest opportunities for the education and training community, such as teachers and students, policymakers, academia, and researchers on a national, EU, and international level, to contribute to an effective digital transformational change.

1.1 Digital Transformation

A rich body of literature contributes to the understanding of the benefits as well as the challenges associated with digital transformation at multiple levels. As Vial (2019) states, digital transformation is

“A process that aims to improve an entity by triggering significant changes to its properties through combinations of information, computing, communication, and connectivity technologies.” (p.118)

Accordingly,

“Innovation is focused on the moment of invention and the implementation of that invention,” but “digital transition is an extended process of change that may have multiple goals.” (Gobble, 2018, p.57)

Controversially, it is still unclear whether, in the context of education, this means introducing or replacing outdated technologies, guaranteeing digital infrastructure and security, aiming at green transactions and resource efficiency, and integrating digital approaches into the curriculum to help students thrive in the new economy, or all of the above (Arinushkina et al., 2023).

What is extensively understood is that digital transformation completely revolutionizes the current economic setting (Majchrzak et al., 2016), and there is a common consensus that building a digital transition for education is significant and will soon serve as a driving force (Negreiro et al., 2019; Hashim et al., 2022; European Commission, 2018; United Nations, 2023). However, school leaders and policymakers have to define the term “digital transformation” to establish a foundation upon which to build a shared vision (Haleem et al., 2022). For this short paper, it makes sense to use the term digital transformation to refer to the transformation that takes advantage of the new opportunities created by the new information and communication technologies in education.

1.2 Digital Transformation in Education

Currently, the digitalization of education is significantly transforming the traditional classroom and administrative processes, creating more engaging learning experiences and improving operational efficiency. With the introduction of technology-assisted learning tools like learning platforms, educational apps, interactive digital content, virtual laboratories, mobile devices, tablets, laptops, smartboards, MOOCs, simulations, and dynamic visualizations, the learning process is transforming, becoming more personalized, inclusive, dynamic, and data-driven (Arinushkina et al., 2023; Al-Emran et al., 2020). These digital platforms and media are said to act as catalysts for a learner-centric model, expanding the alternatives for the delivery and accessibility of educational content everywhere and at any time; students can access resources, participate in discussions, and submit assignments online (Grenčíková, 2021). However, this comes with its risks. It is argued that the claimed change goes beyond just integrating digital

tools; rather, it radically redefines the nature and methods of education (OECD, 2021). Teachers must be equipped to deliver innovative approaches and learning designs that hold the possibility of a safe and meaningful digital transformation (Fisher et al., 2023; Hanelt et al., 2021). This calls for leaders capable of proactively navigating this renovation, ensuring that technology integration aligns with explicit pedagogical goals, enhances student engagement, and ultimately improves learning outcomes (Bush et al., 2019). Hence, additional research on the impact of digital technology on innovative teaching and learning implementation is essential.

1.3 Challenges of Educational Digital Transition

Digital transformation is a process that continually adapts to rapidly emerging digital innovations; as such, it demands agility and has no clear ending. According to McCarthy et al. (2023),

“it needs consideration of industry research reports when envisioning what is required for successful digital transformation, particularly in the areas of strategy and people development, leveraging best practices in the approaches to technical deployment and user experiences.”

Furthermore, there is a necessity to reduce the digital divide and provide equitable access to technology (UNESCO, 2018; Rose et al., 2015). This requires investigating how these emerging technologies might interact with the existing social contexts of education and what the experiences of young people and instructors alike are inside and outside the school eco-system.

In this regard, research argues that the significantly outdated European public digital education programs need to be rapidly updated, from preschools to universities (Global Education Monitoring Report, 2020). The public offering must renovate its curricula to satisfy the demands of the evolving labour market and emerging technologies while guaranteeing access for all. Although technology has proven to play an essential role in shaping the future of education, it also has potential pitfalls. The advent of Industry 4.0 has highlighted the lack of skilled students equipped for the digital and green transition and labor markets (European Commission, 2018) and is claiming a broader and cutting-edge education framework. As more and more job positions become knowledge- and skill-intensive, it will become necessary to be able to transfer existing skills from one industry or occupation to another (Cedefop, 2015a, 2018a; McGuinness et al., 2018). In response to the demands of both individuals and industries, education delivery must simultaneously become more digital, adaptable, and customized (OECD, 2023).

1.4 Strengthening Key Enabling Factors

The urge of digital transformation has led the European Commission (2020) to formulate an updated version of the Digital Education Action Plan (2021–2027) that calls for high-quality, inclusive, and accessible digital education in Europe, especially for the achievement of the European Green Deal objectives, the 2030 Digital Compass, and for reaching climate neutrality by 2050. However, member states have not yet succeeded in bringing about a systemic digital transformation in education and training. They continue to face challenges in securing adequate funding for digital education and training infrastructure, equipment, and digital education content, digital training of educators and staff, and monitoring and evaluation of digital education and training policies (European Commission, 2023). Inevitably, this calls for internal organizational and governance reforms, enabling partnerships with civil society and the market sector, and providing substantial investments in connectivity and new educational initiatives for professors and teachers, ensuring that they have the know-how to effectively use digital tools and to value the importance of digital connection in their practice (Johnson et al., 2016).

A major concern is how quickly schools may develop innovative service models to meet the demands of the rapidly changing digital landscape, especially with the prominence of AI and automation tools, while evaluating the effectiveness of the implementation of new digital solutions for the user's value creation process (Facer et al., 2021). Ongoing assessment, flexible thinking systems, and analysis of the long-term

implications for the shift to digital technology and, ultimately, for the growth of students must be provided. Consequently, collaborating with technology experts, educators, and students is becoming vital in making informed decisions about technology integration. Furthermore, cross-sectoral policies, a shift from standardization to customization, the participation and cooperation of numerous stakeholders, and a determined push for the policy uptake of the schools to address inequality are all necessary (Burns et al., 2018; Cedefop, 2022). In this regard, a new creative architectural blueprint design, a network for research and policy creation that promotes sustainable practices, reporting systems, and the implications for leadership could be tested.

2. Discussion

The significance of the research study, which will be part of a PhD in Service Design for Public Sector at the Sapienza University of Rome, is the analysis of the scientific literature and case studies, such as the Digivisio 2030 program, EIT Digital, EURASHE's strategic framework, and the CoSn consortium, that could enable in-depth, multifaceted assessments of digital issues relating to educational settings and pedagogy.

The aim is to identify the trajectory of technology policy for education within the digital educational landscape, with particular attention to the Italian context, and possibly address the present and recent history.

Of Higher Education to lay the groundwork for an analysis of feasible and successful digital service design solutions. For example, the most recent "Piano scuola.4" strategy plan for schools which foresees the implementation of innovative learning environments integrated with digital, physical, and virtual technologies as part of Italy's educational digital transition (Piano Nazionale di ripresa e resilienza missione 4: istruzione e Ricerca, 2023), defines and sets out a range of possibilities for technology-related provision within the curriculum, and schools are required to proactively respond to it. However, according to the OECD 2023 report,

“due to the somewhat decentralized and highly devolved nature of governance, ensuring the equity of access and use of digital infrastructure and solutions in schools is a challenge,” and more concerning is that “just a few of the publicly provided digital solutions and resources in Italy are mandatory, and schools have significant autonomy to choose and acquire additional components of their digital infrastructure.” (OECD, 2023)

Future research on the topic may zoom in on specific challenges upon which to intervene.

By the considerations made so far, the Research questions is: how do and can Italian public schools allow for digital innovation to continue to improve and update the educational ecosystem?

By following a holistic approach to targeting systemic change, the research project will be conducted by employing an interdisciplinary mode that incorporates information, data, techniques, tools, views, concepts, and theories from multiple fields to meet the set objectives. Through the exploration of how digital innovation diffuses in targeted Italian schools' organisations at the local, regional, and national scale, the research may define their morphology, including their capacity for change, adaptation, inclusivity, interactivity, and pedagogical facilitation. The collection of data among students and teaching staff, using tools such as EUSurvey, could lead to strategic directions that can form the basis for the detection of challenges and opportunities upon which to intervene and may help educational leaders effectively guide their institutions through the digital transformation, ensuring that the move toward digital education is seamless, effective, and beneficial for all stakeholders involved.

In this scenario, the capability of the service design approach, which involves the students, schools, and all stakeholders orchestrating the backstage and frontstage of the educational service, seems beneficial (Trischler et al., 2022). It presents the idea of bottom-up initiatives to establish both a long-term vision and

short-term achievable goals through the “analysis of other sub-factors, such as infrastructure and spaces, school culture, planning strategies, professional development, and teacher ICT - Information Communication Technology-efficacy and ICT integration competence” (Wu et al., 2019, p.1221).

The resulting findings will serve as the theoretical and methodological foundation for the definition of service design approaches and suggestions on the critical characteristics of upcoming innovative educational ecosystems.

3. Conclusion

Building a digital transition for education is acknowledged to be significant and will soon serve as a driving force. Digital transformation involves changing inclusive processes and procedures. Yet, a broad understanding must be made of a sustainable vision of a digital school (Haleem et al., 2022). Challenges detected but for which solutions remain difficult to scale include advancing digital equity, equipping educators, and adapting traditional organizational models to more flexible designs that advance the future of the workplace. To justify digital transformation, policies need to be complemented with a methodical approach that includes explicit priorities and agreed models for growing and sustaining.

The project aims to tackle these issues by linking three main areas: policies (objectives and priorities), virtual space and technology (online/network-based learning and teaching), and social aspects (local, national, and global community). It seeks to define new public educational design services that are co-created collaboratively by actively involving end-users both locally and worldwide in promoting their experiences and sharing data. The network/space will be a living entity with iterations and interactions between students, teachers, and educational leaders that assist schools in the value creation of digital transformation.

References

- Al-Emran, M., Malik, S. I., & Al-Kabi, M. N. (2020). A survey of Internet of Things (IoT) in education: Opportunities and challenges. In *Toward Social Internet of Things (IoT): Enabling technologies, architectures, and applications* (Vol. 846). Springer. https://doi.org/10.1007/978-3-030-24513-9_12
- Arinushkina, A. A., Morozov, A. V., & Robert, I. V. (2023). The impact of digitalization in a changing educational environment. *Advances in Educational Technologies and Instructional Design (AETID) Book Series*. IGI Global. <https://doi.org/10.4018/979-8-3693-0433-4>
- Bush, T., Middlewood, D., & Bell, L. (2019). *Principles of educational leadership & management* (1st ed.). Sage.
- Burns, T., & Köster, F. (2018). *Educational research and innovation: Governing education in a complex world*. OECD Publishing. <https://doi.org/10.1787/9789264290877-en>
- Cedefop. (2015). *Skills, qualifications, and jobs in the EU: The making of a perfect match? Evidence from Cedefop's European skills and jobs survey*. Publications Office of the European Union. Cedefop reference series, No. 103.
- Cedefop. (2018). *Skills forecast: Trends and challenges to 2030*. Publications Office of the European Union. Cedefop reference series, No. 108.
- Cedefop. (2022). *Setting Europe on course for a human digital transition: New evidence from Cedefop's second European skills and jobs survey*. Publications Office of the European Union. Cedefop reference series, No. 123.

Dawson, O., Poquet, O., Rogers, C., Colvin, C., Pardo, A., & Gašević, D. (2018). 8th International Conference on Learning Analytics and Knowledge, LAK 2018. <https://doi.org/10.1145/3170358.3170375>

European Commission. (2018). *Digital education action plan 2018*. Publications Office of the European Union.

European Commission. (2020). *Communication on a European Skills Agenda for sustainable competitiveness, social fairness, and resilience*. Publications Office of the European Union.

European Commission. (2023). *Enabling digital education and providing digital skills: Commission calls for a massive boost*. Press release. Publications Office of the European Union.

Facer, K., & Selwyn, N. (2021). Digital technology and the futures of education – Towards 'non-stupid' optimism. *Paper commissioned for the UNESCO Futures of Education report*.

Fischer, G., Lundin, J., & Lindberg, O. J. (2023). The challenge for the digital age: Making learning a part of life. *The International Journal of Information and Learning Technology*, 40(1), 1–16. <https://doi.org/10.1108/IJILT-04-2022-0079>

Gobble, M. M. (2018). Digitalization, digitization, and innovation. *Research-Technology Management*, 61(4), 56–59. <https://doi.org/10.1080/08956308.2018.1471280>

Grenčíková, A., Kordoš, M., & Navickas, V. (2021). The impact of Industry 4.0 on education contents. *Business: Theory and Practice*, 22(1), 29–38. <https://doi.org/10.3846/btp.2021.13166>

Haleem, A., Javaid, M., Qadri, M. A., & Suman, R. (2022). Understanding the role of digital technologies in education: A review. *Sustainable Operations and Computers*, 3, 275–285. <https://doi.org/10.1016/j.susoc.2022.05.004>

Hanelt, A., Bohnsack, R., Marz, D., & Antunes Marante, C. (2021). A systematic review of the literature on digital transformation: Insights and implications for strategy and organizational change. *Journal of Management Studies*, 58(5), 1159–1197. <https://doi.org/10.1111/joms.12639>

Hashim, A., Tlemsani, M., & Matthews, I. (2022). Higher education strategy in digital transformation. *Education and Information Technologies*, 27. <https://doi.org/10.1007/s10639-021-10739-1>

Johnson, A. M., Jacovina, M. E., Russell, D. E., & Soto, C. M. (2016). Challenges and solutions when using technologies in the classroom. In S. A. Crossley & D. S. McNamara (Eds.), *Adaptive educational technologies for literacy instruction* (pp. 13–29). Taylor & Francis. <https://doi.org/10.4324/9781315647500-2>

Majchrzak, A., Markus, M. L., & Wareham, J. (2016). Designing for digital transformation: Lessons for information systems research from the study of ICT and societal challenges. *MIS Quarterly*, 40(2), 267–277. <https://doi.org/10.25300/MISQ/2016/40.2.03>

McCarthy, A. M., Maor, D., McConney, A., & Cavanaugh, C. (2023). Digital transformation in education: Critical components for leaders of system change. *Social Sciences & Humanities Open*, 8(1), 100479. <https://doi.org/10.1016/j.ssaho.2023.100479>

McGuinness, S., Pouliakas, K., & Redmond, P. (2018). Skills mismatch: Concepts, measurement, and policy approaches. *Journal of Economic Surveys*, 32(4), 985–1015. <https://doi.org/10.1111/joes.12254>

Negreiro, T., & Madiega, T. (2019). *EU policies – Delivering for citizens: Digital transformation*. European Parliamentary Research Service.

OECD. (2019). *Future of education and skills 2030*. Organisation for Economic Co-operation and Development.

OECD. (2021). *OECD digital education outlook 2021: Pushing the frontiers with artificial intelligence, blockchain, and robots*. OECD Publishing. <https://doi.org/10.1787/589b283f-en>

OECD. (2023). *Country digital education ecosystems and governance: A companion to digital education outlook 2023*. OECD Publishing. <https://doi.org/10.1787/906134d4-en>

Piano scuola 4. (2023). *Piano Nazionale di ripresa e resilienza missione 4: Istruzione e ricerca*. <https://doi.org/10.1007/s00163-024-00436-8>

Rose, P., & Alcott, B. (2015). *How can education systems become equitable by 2030?* DFID Think Pieces – Learning and Equity. Report prepared for the UK Department for International Development. Health and Education Advice and Resource Team.

Selander, L., & Jarvenpaa, S. L. (2016). Digital action repertoires and transforming a social movement organization. *MIS Quarterly*, 40(2), 331–352. <https://doi.org/10.25300/MISQ/2016/40.2.03>

Trischler, J., & Westman Trischler, J. (2022). Design for experience: A public service design approach in the age of digitalization. *Public Management Review*, 24(8), 1251–1270. <https://doi.org/10.1080/14719037.2021.1899272>

UNESCO. (2018). *Handbook on measuring equity in education*. UNESCO.

United Nations. (2023). *The Sustainable Development Goals report 2023: Special edition*. United Nations.

Vial, G. (2019). Understanding digital transformation: A review and a research agenda. *The Journal of Strategic Information Systems*, 28(2), 118–144.

Wu, X., Yu, Y., & Hu, J. (2019). How does principal e-leadership affect ICT transformation across different school stages in K-12 education: Perspectives from teachers in Shanghai. *British Journal of Educational Technology*, 50(3), 1210–1225. <https://doi.org/10.1111/bjet.12766>

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