The Educational Path for the use of the Technologies in Portuguese schools. An evaluation about the PADDE instrument for a sustainable education

Ana Pego

Abstract

In recent years, Portuguese schools have entered a new era of teaching based on the use of technology. Capacity building and its impact on the education system have led to the development of new educational methodologies, as well as new challenges in using technology. In this context, the potential use of technology and its impact on students, teachers, and the community have contributed to more sustainable education. This article describes the PADDE methodology, its resilience among teachers, and its application for sustainable education. The methodology used to obtain the results was a direct questionnaire administered to teachers in a Portuguese school. The results showed a consistent relationship between the use of technology and sustainable education when following the PADDE methodology. It is expected that this methodology will be useful at all levels of education and serve as a valuable tool for evaluating, in the long term, the relationship between technology and educational efficiency.

Keywords: education, PADDE, technologies, education sustainability

Résumé

Ces dernières années, les établissements scolaires portugais sont entrés dans une nouvelle ère pédagogique fondée sur l'utilisation des technologies. Le renforcement des capacités et ses effets sur le système éducatif ont favorisé le développement de nouvelles méthodes pédagogiques, tout en faisant émerger de nouveaux défis liés à l'utilisation des technologies. Dans ce contexte, le potentiel des technologies et leurs effets sur les élèves, les enseignants et la communauté ont contribué à une éducation plus durable. Cet article décrit la méthodologie PADDE, la résilience des enseignants dans sa mise en œuvre et son application à une éducation durable. Les résultats ont été obtenus au moyen d'un questionnaire administré directement aux enseignants d'un

Doi: https://doi.org/10.24140/issn.1645-7250.rle.11240

établissement scolaire portugais. Ils ont révélé une relation cohérente entre l'utilisation des technologies et l'éducation durable dans le cadre de la méthodologie PADDE. Cette méthodologie devrait pouvoir être utilisée à tous les niveaux d'enseignement et constituer un outil précieux pour évaluer, à long terme, la relation entre les technologies et l'efficacité éducative.

Mots-clés : éducation ; PADDE ; technologies ; durabilité de l'éducation

Resumo

Nos últimos anos, as escolas portuguesas entraram numa nova era de ensino assente na utilização da tecnologia. A capacitação e o seu impacto no sistema educativo têm impulsionado o desenvolvimento de novas metodologias pedagógicas, bem como o surgimento de novos desafios associados à utilização da tecnologia. Neste contexto, o potencial da tecnologia e o seu impacto nos alunos, nos professores e na comunidade têm contribuído para uma educação mais sustentável. Este artigo descreve a metodologia PADDE, a resiliência dos professores na sua implementação e a sua aplicação a uma educação sustentável. Os resultados foram obtidos através de um questionário aplicado diretamente aos professores de uma escola portuguesa. Estes evidenciaram uma relação consistente entre a utilização da tecnologia e a educação sustentável no âmbito da metodologia PADDE. Espera-se que esta metodologia possa ser utilizada em todos os níveis de ensino e constitua uma ferramenta relevante para avaliar, a longo prazo, a relação entre a tecnologia e a eficiência educativa.

Palavras-chave: educação; PADDE; tecnologias; sustentabilidade da educação.

Resumen

En los últimos años, los centros educativos portugueses han entrado en una nueva era de enseñanza basada en el uso de la tecnología. El fortalecimiento de las capacidades y su impacto en el sistema educativo han impulsado el desarrollo de nuevas metodologías pedagógicas, así como la aparición de nuevos retos asociados al uso de la tecnología. En este contexto, el potencial de la tecnología y su impacto en el alumnado, el profesorado y la comunidad han contribuido a una educación más sostenible. Este artículo describe

la metodología PADDE, la resiliencia del profesorado en su implementación y su aplicación a una educación sostenible. Los resultados se obtuvieron mediante un cuestionario administrado directamente al profesorado de un centro educativo portugués. Estos mostraron una relación consistente entre el uso de la tecnología y la educación sostenible en el marco de la metodología PADDE. Se espera que esta metodología pueda utilizarse en todos los niveles educativos y constituya una herramienta valiosa para evaluar, a largo plazo, la relación entre la tecnología y la eficiencia educativa.

Palabras clave: educación; PADDE; tecnologías; sostenibilidad de la educación.

1- Introduction

The use of digital methodology in schools involves understanding digital skills not only by students but also by teachers. Aligning digital tools with teaching capacity presents a significant challenge, as it tests the ability to use tools and methods for different approaches to learning. Pego (2022) discusses the use of technology in teaching and learning methodologies after COVID-19. The results of her research focus on schools' capacity building in technology and the resilience of the school community. In fact, some difficulties in using technology in the classroom, both from students and teachers, are highlighted, which has been confirmed by other authors (Alam et al., 2025; Chen et al., 2025). The PADDE was created to provide an opportunity for the system to implement digital skills in schools and to promote inclusivity. Changing patterns and resilience in schools have become important due to challenging methodological approaches from the European Commission. Additionally, the sustainable development of digital tools in schools, aligned with new proficiency, has given schools the opportunity to increase participation in collaborative work and has emphasised the importance of developing digital skills within the school. This article summarises recent research on the PADDE and analyses it in comparison with other studies presented by the European Commission and the OECD. An important question arising from the use of digital tools in the education sector is how participants have benefited from their use. The implementation of digital education and its associated difficulties provides an

overview of the stage each organisation has reached, which also presents a valuable challenge to analyse potential and how they can manage to create sustainable education.

The articles provide a conclusion about a study case in technological assessment and give directions for future research on digital education and sustainability. The article is divided into five mains points, the first gives an introduction to the topic, the second provides an overview of the technological approach for the sustainable education (2021–2027), the third, provides a methodological analysis, and fourth, indicates the capacity building for a sustainable use in the Portuguese schools based on the technological approach, and finally the fifth, makes a conclusion and further developments on digital education and sustainability at schools.

2- The Technological approach for the sustainable education

Technological education constitutes one of the most important issues in Europe. Capacity building in schools based on a technological pathway is aligned with sustainable education (Leal et al., 2009). Technological change from new technologies such as digitalisation, genomics and artificial intelligence offer substantial economic, social, and environmental benefits as well as significant challenges to equality, governance, and social inclusion[1]. Additionally, the use of technologies as a problem-solving tool associated with sustainable education is consistent with the aims of inclusive education (Middleton, 2009; Pavlova, 2013).

In fact, more recently, European countries have been facing a new methodological challenge based on the use of technology and its role in sustainable education. The emergence of this new challenge, aligned with new values regarding technological performance in schools, has gained prominence in educational methodological directives (Agarwal et al., 2025), where AI can be seen as a transformative force in the educational system. Education 5.0, which promotes agreeable and inclusive learning, contributes to developing skilled, adaptable talent and innovation capacity (Anjarwati et al., 2025; Chigbu and Makapela, 2025; Judijanto and Wardhana, 2025).

[1] https://www.oecd.org/content/dam/oecd/en/publications/reports/2023/08/measuring-innovation-in-education-2023_37b7c525/a7167546-en.pdf, consulted in 21/01/2026

According to OCDE[2] teachers' use of AI varies by country and by the education level they teach. Regardless of education level, teachers report mainly using GenAI tools for the same purposes: generating lesson plans, pedagogical activities, teaching and learning materials, and occasionally providing feedback to students. This is related to digital innovation, OCDE [3] identifies three policies and practices that can foster innovation: a pro-innovation culture, knowledge and capabilities, and innovation management.

Aligned with the promotion of digital education and its impact on students and teachers in schools, the EC has developed a new educational policy based on digital education[4]. The aim is to promote an educational ecosystem that enhances competences and skills for the digital transition. This also presents new challenges and opportunities for European students and teachers. According to the European Commission, innovative educational policy comprises a new methodology to ensure inclusivity at all levels of education, through training and the use of digital tools. The implementation of the Digital Platform[5] for Portugal was based on PADDE (DGE, 2021b) as a strategic plan for educational system development and sustainability.

The evaluation on the platform concludes that there is a need for transformation and investment to promote inclusive and sustainable use of technology and its resilience. This indicates new potential for the education system, based on two strategic plans: first, prioritising ecosystem development in digital education, and second, empowering the transformation of digital skills. Both strategies are founded on a new approach to sustainable education, emphasising the importance of digital transformation in schools and pedagogical methodology, aligned with the significance of digital skills for citizens. Sustainable education and technologies are aligned with the capacity of promoting digital skills (Fitroni et al, 2025) but also the challenge of using it, namely 1) changes in aims and objectives; 2) changes in educational ecologies; 3) changes in our conceptions of teaching and learning; 4) changes that specifically affect teachers; and 5) changes in Governance (Burbules et al., 2020).

---

[2] https://www.oecd.org/content/dam/oecd/en/publications/reports/2026/01/oecd-digital-education-outlook-2026_940e0dd8/062a7394-en.pdf , consulted in 20/01/2026

[3] https://www.oecd.org/content/dam/oecd/en/publications/reports/2023/08/measuring-innovation-in-education-2023_37b7c525/a7167546-en.pdf, consulted in 20/01/2026

[4] https://education.ec.europa.eu/focus-topics/digital-education, consulted in 20/01/2026

[5] https://education.ec.europa.eu/focus-topics/digital-education/action-plan/european-digital-education-hub, consulted in 20/01/2026

Based on this, the Portuguese government has set 3 pillars to implement the digital transformation at schools (DGE, 2021a.). The capacity building in this strategy aims to drive digital transformation towards a new pedagogical process in schools, while also fostering competitiveness among European countries. The strategy encompasses three dimensions – organisational, pedagogical, and technological – which promote a new era for the educational sector.

In this paper we discuss the technological dimension. The roadmap for the digital education in Portugal follows the capacity of implementing the digital strategies in education system, but also the capacity of its implementation (DGE, 2021a).

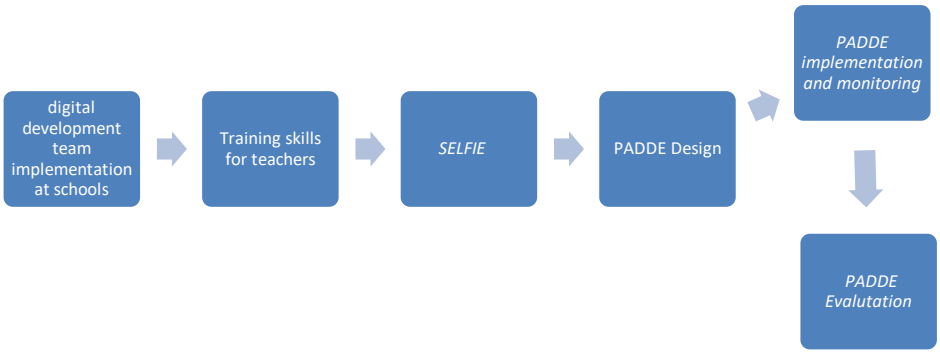

Figure 1- Digital Development Roadmap

Source: DGE (2023)

The evaluation of digital development and its implementation in schools allows the conclusion that digital capacity building in schools has decreased since 2021/2022, which indicates a reduction in teacher training. On the other hand, it is possible to conclude that level 2 (the level of digital skills where level 1 is limited use of digital tools, level 2 is moderate use, and level 3 is proficiency and innovation) of capacity building by teachers constitutes the most important training. Overall, it is possible to conclude that digital education in Portugal has been a complex process, focused on improving digital skills for both students and teachers, while investments in infrastructure to support digital upgrades have increased since 2021, namely the LED[6].

Analogies with Portugal and Europe can be drawn based on the assumption that digital capacity building and its sustainability in schools are at different stages of implementation and human resource skills (Gkoutis et al., 2025; Wastiau et al., 2024).

[6] https://led.dge.medu.pt/ , consulted in 21/01/2026

The readiness for digital transformation in schools is complex, as countries are at varying stages of implementation. However, it is important to note that the European Commission and national education policies are working in the same direction towards a digital and inclusive path for teachers and students, focusing mainly on enhanced digital skills and new pedagogical methodologies aligned with the supportive planning for 2021–2027.

3- The methodological approach based on the study case

The methodology was based on the research presented by Cruz (2025). However, it was also assumed that, to validate the results, additional sources from the EC and OECD were necessary. In fact, a comparison between Cruz (2025) and the official publications validated some of the results.

The study is an exploratory case at a secondary school in Faro (Portugal) and provides an overview of technology use and its perception when teachers employ it for academic purposes. The school involved in this study is a public school, where students have access to technologies provided by the Portuguese government. Students also have access to computers when needed during lessons, where teachers can provide support to develop computer skills.

The study employs a mixed methodology, testing quantitative analysis through a direct questionnaire with a Likert scale and qualitative research based on direct questions to the Padde Coordinator. For this research, the author focuses on one hypothesis: the implementation of technological approaches by teachers promotes a positive impact, and the research question: "What is the impact of digital education on teachers?" This research focused on the technological dimension of the questionnaire. This means that it is notice that the teachers have a positive perception of technological access at the school and are able to promote the development of digital competences.

The questionnaire was administered to 262 teachers at different teaching levels, with 38% of these responses validated between March and April 2025. The questionnaire stems from the need to understand why the implementation of PADDE was so important in the school, and also the technological implementation in this specific environment, since the school is one of the biggest in Faro city and supports different

levels of training and regular studies. The research is also committed to describing the level of teachers' digital interest and their adoption of new methodologies in the classroom.

Since the PADDE is a methodological instrument designed to achieve a different scientific methodology in the classroom, in this article we present only the technological dimension, although the complete analysis also reflects the pedagogical influence.

The results about the technological and digital dimension, represented by infrastructure and equipments showed that there is a positive correlation between with the professional development ($r = 0,644$, $p < .01$) and digital skills in students ($r = 0,566$, $p < .01$)**,** which allows concluding that the study case has good technical infrastructure, and it's linked with pedagogical practices towards a digital capacity building in students.

Table 1- Digital Resources Perception by Teachers

Equipment and Infrastructures	• 17 % of the teachers disagree that the digital equipment support the education methodology; • 9% totally agree that it is not easy to access to the 'internet' and 35% partially; • 12% totally agree that there is insufficient technical support, and 41% partially; • 50% agree that the students don't have access easily to digital equipment;

Source: Adopted from Cruz (2025)

On the other hand, the results showed that teachers have a weak connection with certain indicators at schools, such as internet access and outdated equipment, which negatively affect digital literacy for both students and teachers. Technical support at school is also identified as a significant negative factor. The questionnaire indicates that investment in digital education is necessary to achieve digital transformation at the school.

Since the three dimension tested (digital, pedagogical and organisational) cannot be separated its correlation showed that the most important factors for digital transformation (based on the Pearson test with 1% significant correlation) are: personal and professional development (0.644), followed by students' digital skills (0.566), and

collaborative networking (0.552). Less significant factors include leadership skills (0.519), pedagogical skills in the classroom (0.452), pedagogical resources support (0.345), and, least important, evaluation techniques (0.304).

The results also showed that digital transformation can be achieved if the organisation listens to teachers and their digital needs, provides training in digital skills, and encourages networking among teachers to discuss further developments in this area.

To conclude the research analysis the author has compared the results with the EC and OCDE data in order to give a consistent explanation about the technology and digital dimension.

4- The capacity building for a sustainable use in the Portuguese schools based on the technological approach

The latest report about the digital education presented by OCDE[7] describe a linkage between the educational policy and the digital tools, where digital educations strategies cover technological infrastructure and capacity building, which confirms the study presented in this research.

The same report also identifies thematic areas that confirm the responses presented in point 3, namely: digital resources used by teachers, digital devices and software for schools, and teachers' capacity to integrate digital resources. There are, in fact, similarities between the educational plan aligned with digital education and the strategic plan for Portugal, which aims for greater sustainability and a technological approach. In line with digital skills and their application in schools, digital innovation can play an important role in the future of educational performance, as the use of innovation can contribute significantly to greater competitive advantage (Ordoñez, 2025).

A new approach to sustainable educational development arises from effective learning through PADDE in Portuguese schools. In fact, its resilience in improving a new teaching methodology aligns with the EC digital plan and the OECD. The results from the questionnaire presented in point 3 are consistent with studies in the national literature on the implementation of PADDE (DGE & ISCTE, 2024a; DGE, 2024b),

[7] Policies for the digital transformation of school education (EN), consulted in 22/01/2026

which highlight the lack of digital infrastructure, human resources, and internet connectivity as barriers to achieving a positive impact of digital education in schools.

According to Cruz (2025), it is possible to evaluate the implementation of PADDE in Portuguese schools. The main positive impacts are increased student involvement, improvement in teachers' academic skills, and the adoption of technological methodologies by teachers. The negative impacts include limited technological infrastructure and the need for further training.

Bo (2025) noted that human resources can promote technological capacity building, confirming the need for digital training among Portuguese teachers to develop greater digital competences, opportunities, and approaches for professional development. In this context, it is important to emphasise the significance of digital skills in Portuguese schools and to identify the factors contributing to negative outcomes. Thus, digital education and a sustainable approach benefit from several aspects, namely: 1. The preparatory work carried out using SELFFIE allows conclusions to be drawn about the importance of digital education in Portuguese schools, highlighting the need for new equipment and human resources to support the implementation of the Digital Plan (2021–2027); 2. The methodological aspects and their resilience among teachers indicate that not all teachers use digital skills to follow the Digital Plan in schools, as there is a lack of human resources to provide adequate support; 3. Digital skills vary among students and teachers; 4. Access to digital education is not equal across all schools.

Additionally, assuming there are weak variables in the education system that should be analysed, the study confirms that, according to the research question on the impact of digital education on teachers, there is a positive effect when teachers use digital equipment aligned with digital skills. However, as noted, digital education and the lack of equipment are the most important aspects to consider in digital education.

In conclusion, it is important to emphasise that digital sustainability for both teachers and students should be described as ongoing, as schools face various challenges in digital implementation. In the long term, the sustainability of the education system should be more closely aligned with the needs of each school and prepare them for the future. New investments in human resources and equipment should be prioritised to achieve an effective impact on the education system in Portugal.

4- Conclusion and further discussion

Despite the differences between what the government aims to achieve and the reality in Portuguese schools, it is noted that the strategic plan (PADDE) for 2021–2027 in Portugal will provide a comprehensive methodology to promote inclusivity among teachers and students.

The most important point to understand is the focus on capacity building in schools and the effort to deliver new competences. In the long term, it is expected that a sustainable path will be established, along with new ways of promoting digital skills among students and teachers. Additionally, more active learning in digital skills is anticipated in Portuguese schools, as well as their application in educational methodologies. Furthermore, the expectation of a suitable model, based on the assumption that digital skills can be aligned with OECD standards, underpins the Portuguese Government's commitment to adopting new challenges for teachers.

The article assume that technological aspect at schools should address a more comprehensive analysis based on the relationship between the users and the technologies, and promote at same time a discussion about the usefulness of the use of new methodologies approach in class by teacher when they are using technologies. This is also a good starting point to address the capacity building at schools about the use of the new technological centres by students and teachers. The last question should be, are the users ready for changes in short term?

Bibliography

Agarwal, V., Verma, P., & Ferrigno, G. (2025). Education 5.0 challenges and sustainable development goals in emerging economies: A mixed-method approach. *Technology in Society*, *81*, 102814.

Alam, T. M., Stoica, G. A., Sharma, K., & Özgöbek, Ö. (2025, February). Digital technologies in the classrooms in the last decade (2014–2023): A bibliometric analysis. In *Frontiers in Education* (Vol. 10, p. 1533588). Frontiers Media SA.

Anjarwati, A., Qomariyah, R. S., Prameswari, D. A., Laili, S. N., & Wahyuningrum, P. D. R. (2025). Transforming Science Learning in the Era of Education 5.0 Through Virtual Reality (VR) Millea Lab: Improving Understanding of Science Concepts and

Technological Literacy for Digital Native Students. *Journal Penelitian Pendidikan IPA*, *11*(11), 256-264.

Bo, N. S. W. (2025). OECD digital education outlook 2023: Towards an effective education ecosystem. *Hungarian Educational Research Journal*, *15*(2), 284-289.

Burbules, N. C., Fan, G., & Repp, P. (2020). Five trends of education and technology in a sustainable future. *Geography and sustainability*, *1*(2), 93-97.

Chen, C. H., Fei, H. Y., & Tsai, C. C. (2025). Hierarchical analysis of in-service teachers' barriers to technology-integrated instruction: A review of 2000-2024 publications. *Computers & Education*, 105509.

Chigbu, B. I., & Makapela, S. L. (2025). AI in education, sustainability, and the future of work: An integrative review of industry 5.0, education 5.0, and work 5.0. *Journal of Open Innovation: Technology, Market, and Complexity*, 100645.

Cruz, N.C.L.(2025). *Perceção dos professores em relação ao impacto do Plano de Ação para o Desenvolvimento Digital das Escolas (PADDE): Estudo de caso num Agrupamento de Escolas do concelho de Faro*. Thesis Dissertation, Universidade do Algarve. Portugal

Direção-Geral da Educação (2021a). Capacitação Digital das Escolas: Documento Orientador. Ministério da Educação. Portugal

Direção-Geral da Educação. (2021b). Plano de Ação para o Desenvolvimento Digital das Escolas (PADDE). https://digital.dge.mec.pt/desenvolvimento-digital-das-escola

Direção-Geral da Educação. (2023). *Plano de Ação para o Desenvolvimento Digital da Escola (PADDE)*. Ministério da Educação.

Direção-Geral da Educação. (2024a). *Estudo sobre a Implementação dos Planos de Ação de Desenvolvimento Digital das Escolas (PADDE)*. Instituto Universitário de Lisboa – Centro de investigação e Estudos de Sociologia; Ministério da Educação. https://www.dge.mec.pt/noticias/estudo-sobre-implementacao-e-o-impacto-dos-planos-de-acao-de-desenvolvimento-digital-das 103

Direção -Geral da Educação. (2024b). *SELFIE – Desenvolvimento Digital das Escolas: Relatório nacional 2023/2024*. Ministério da Educação.

Fitroni, W., Ramadani, Y. S., Cahya, R. D., Rosyadi, M. R. E., & Hulu, N. M. (2025). Literature review: The use of professional technology in the integration of esd (education for sustainable development) in social science learning. *Journal of Innovative Technology and Sustainability Education*, *1*(2), 79-79.

Gkoutis, G., Thode, M., & Paliokas, I. (2025). A European Examination of Digital Education Strategies: Broader Insights into Policy Adoption and Economic Impact. *Digital Society*, *4*(2), 53.

Judijanto, L., Ili, L., & Wardhana, M. G. (2025). EDUCATION 5.0: COLLABORATION AND CREATIVITY IN IMPROVING STUDENTS'DIGITAL INTELLIGENCE. *International Journal of Teaching and Learning*, *3*(4), 369-382.

Leal Filho, W., Manolas, E., & Pace, P. (2009). Education for sustainable development: current discourses and practices and their relevance to technology education. *International Journal of Technology and Design Education*, *19*(2), 149-165.

Middleton, H. (2009). Problem-solving in technology education as an approach to education for sustainable development. *International Journal of Technology and Design Education*, *19*(2), 187-197.

Ordoñez de Pablos, P. (2025). Advanced digital technologies, competitive edge and economic growth: insights for the green and digital transitions. *Journal of Science and Technology Policy Management*, *16*(6), 979-983.

Pavlova, M. (2013). Teaching and learning for sustainable development: ESD research in technology education. *International journal of technology and design education*, *23*(3), 733-748.

Pego, A. (2022). Perspective for a Digital Teaching Method: A Case Study About Secondary Schools During the COVID-19 Era in the Algarve Region. In *Handbook of Research on Digital Innovation and Networking in Post-COVID-19 Organizations* (pp. 406-416). IGI Global Scientific Publishing.

Wastiau, P., Looney, J., & Laanpere, M. (2024). Portugal's digital transition strategy for education. *System change case studies series. Brussels, European Schoolnet*.

Ana Pego
CinTurs, Universidade do Algarve
https://orcid.org/0000-0002-4161-7301
acpego@ualg.pt

Submissão: abril, 2026

Ana Pego, The Educational Path for the use of the Technologies in Portuguese schools. An evaluation about the PADDE instrument for a sustainable education

Avaliação: abril-outubro, 2026

Publicação: novembro, 2026