

# Digital Capacity Building in Schools: Strategies, Challenges, and Outcomes

**Le renforcement de la capacité numérique d'un établissement  
d'enseignement : stratégies, défis et résultats**

**Construyendo la capacidad digital en las escuelas: estrategias,  
desafíos y resultados**

<https://doi.org/10.52358/mm.vi13.394>

Christiane Caneva, Head of the Service for University didactics and digital skills  
University of Fribourg, Switzerland  
[christiane.caneva@unifr.ch](mailto:christiane.caneva@unifr.ch)

Caroline Pulfrey, Lecturer and Senior researcher  
University of Lausanne, Switzerland  
[caroline.pulfrey@unil.ch](mailto:caroline.pulfrey@unil.ch)

---

## ABSTRACT

The introduction of digital technologies in educational institutions has gained significant momentum worldwide as societies recognize the central role of education in preparing individuals for a technology-driven world. This paper explores the concept of 'school digital capacity', which encompasses various factors critical to the effective integration of technology into teaching and learning practices. Educational leadership emerges as a cornerstone of this capacity, with leaders playing a critical role in shaping the digital landscape of their institutions. Using a mixed-methods approach, this research explores the perceptions of educational leaders in the context of a large-scale digital education reform project. Key findings highlight the importance of leadership and a coherent digital strategy in improving digital efficacy and teacher engagement with technology. However, challenges are evident, including a lack of clear strategies, inadequate human resource allocation, limited knowledge of digital education



and insufficient professional development opportunities. The study highlights the need for improved training programmes for educational leaders to equip them with the necessary digital skills and strategic acumen. Collaborative networks between schools and increased support from ministries of education are recommended to facilitate effective digital integration and capacity development.

**Keywords:** leadership, strategy, digital technologies, school digital capacity

#### RÉSUMÉ

L'introduction des technologies numériques dans les établissements d'enseignement a pris de l'ampleur dans le monde entier, car la société reconnaît le rôle central de l'éducation dans la préparation des étudiants à un monde numérique. Cet article explore le concept de « capacité numérique de l'école », englobant plusieurs facteurs pour l'intégration efficace des technologies dans l'enseignement et l'apprentissage. Le leadership apparaît comme la pierre angulaire, les dirigeants jouant un rôle essentiel dans le développement de la capacité numérique. En utilisant une approche mixte, cette recherche explore les perceptions des leaders dans une réforme à grande échelle de l'éducation numérique. Les résultats soulignent l'importance du leadership et d'une stratégie numérique cohérente pour améliorer l'engagement des enseignants vis-à-vis des technologies. Cependant, les défis sont nombreux : le manque de stratégies claires, l'allocation inadéquate des ressources humaines, la connaissance limitée de l'éducation numérique et l'insuffisance des opportunités de développement professionnel pour les leaders. L'étude souligne la nécessité d'améliorer les programmes de formation destinés aux responsables de l'éducation afin de les doter des compétences numériques et de la perspicacité stratégique nécessaires. Des réseaux de collaboration entre les écoles et un soutien accru des ministères de l'Éducation sont recommandés pour faciliter le déploiement des technologies numériques.

**Mots-clés :** leadership, stratégie, capacité numérique, technologies numériques

#### RESUMEN

La introducción de las tecnologías digitales en los centros educativos ha cobrado impulso en todo el mundo, a medida que la sociedad reconoce el papel central de la educación en la preparación de los alumnos para un mundo digital. Este artículo explora el concepto de "capacidad digital escolar", que engloba una serie de factores para la integración eficaz de las tecnologías en la enseñanza y en el aprendizaje. El liderazgo surge como piedra angular, ya que los líderes desempeñan un papel esencial en el desarrollo de la capacidad digital. Mediante un enfoque de métodos mixtos, esta investigación explora las percepciones de los líderes en el marco de una reforma de la educación digital. Los resultados destacan la importancia del liderazgo y de una estrategia digital coherente para mejorar el compromiso de los profesores con la tecnología. Sin embargo, existen muchos retos: falta de estrategias claras, asignación inadecuada de recursos humanos, conocimiento limitado de la educación digital y oportunidades insuficientes de desarrollo profesional para los líderes. El estudio



destaca la necesidad de mejorar los programas de formación de los responsables educativos para dotarles de las competencias digitales y la visión estratégica necesarias. Para facilitar el despliegue de las tecnologías digitales se recomienda el uso de redes de colaboración entre centros escolares y un mayor apoyo de los ministerios de educación.

**Palabras clave:** liderazgo, estrategia digital, tecnologías digitales, capacidad digital escolar

---

## Introduction

A number of reforms introducing digital technologies in educational institutions have been implemented at state level in recent years (OECD, 2015) as education and training systems are crucial in preparing people for a technology-driven world (Bourgeois, Birch, & Davydovskaia, 2019). Most countries in the European community have defined “digital education action plans” to support the adaptation of education and training systems, to foster the development of a performing digital education ecosystem (European Commission, 2020) and, more generally, to improve digital capacity in educational institutions (Costa, Castano-Munoz & Kampylis, 2021).

As we see above, leadership, strategy and digital capacity come together to provide a comprehensive framework for understanding and implementing digital education in educational institutions (Costa, Castano-Munoz & Kampylis, 2021). But what do these concepts actually mean and why are they all necessary components of digital progress in schools?

## Digital education

By "digital education" we mean teaching students computer science, information and communication technologies [ICT] and digital citizenship, as defined in the curriculum in force in the region of Switzerland (Vaud) where this study was conducted.

## Digital capacity

The digital capacity of an educational institution is defined as “the extent to which culture, policies, infrastructure as well as digital competence of students and staff support the effective integration of technology in teaching and learning practices” (Costa, Castano-Munoz & Kampylis, 2021). In other words, school digital capacity encompasses a range of factors that contribute to the effective use of digital technologies in education. These factors include the attitudes and skills of teachers and students towards technology, the availability and quality of digital infrastructure, and the policies and practices that support the integration of technology into teaching and learning. A school with a strong digital capacity is supposed to be better equipped to provide students with the skills and knowledge needed to thrive in a technology-driven world, and to prepare them for their future and, by assessing school digital capacity, educators and policymakers can identify areas for improvement and develop strategies to enhance the use of digital technologies in education.



## Leadership

Leadership, and more specifically educational leadership, has been identified by several researchers as a key factor in the success of projects aimed at developing digital education in an educational establishment. Liljenberg (2015) explains that “leadership is seen as important for creating a developing and learning school organisation” (p. 152). A successful component in creating opportunities for the expansion of digital technologies in education is how leaders lead this work (Agélii Genlott et al., 2021). According to Pulfrey & Caneva (2023), one of the key factors associated with the school digital capacity is leadership. Educational leaders are key players for digital development in schools (Ruloff & Petko, 2022) and for the implementation of 1:1 initiatives (Bocconi, Kampylis & Punie, 2013), as they create the conditions for the use of digital technologies in teaching and learning (Håkansson Lindqvist, 2019).

This role is important as Ismail *et al.* (2021) show a correlation between effective technology leadership and teachers’ self-efficacy. Research in the industry sector shows that leaders in the digital age could inspire employees to embrace the change, which is often perceived as a threat to the status quo (Kirkland, 2014). Leadership in the digital age goes beyond the provision of hardware and software, and involves defining and aligning objectives with organisational structures, digital devices and workforce capacity building, so that change is seen as meaningful (Cortellazzo, Bruni & Zampieri, 2019). It also includes managing ethical issues (Cortellazzo, Bruni & Zampieri, 2019), which is even more important with the advent of AI in education. Leaders need to give clear indications to all members of the organisation and act as role models to clarify what ethical behaviour looks like when dealing with sensitive personal data (Gheni *et al.*, 2016). They also take on the role of digital change agents and digital enablers, which means recognising the opportunities offered by technologies and driving their implementation (Gert & Peppard, 2016).

## Strategy and strategic planning

Educational leaders need strategic planning because it helps them to develop and implement effective policies and strategies to achieve the desired outcomes and improve the quality and equity of education (Carvalho *et al.*, 2021), to allocate resources efficiently and to monitor and evaluate the progress and impact of the plan and make necessary adjustments based on the feedback and evidence (Carvalho *et al.*, 2021; Caneva & Brabant, 2023) and to foster a culture of collaboration, innovation, and learning among the staff and the partners of the institution (Davies & Davies, 2010).

Quinn (1980), referring to organizational processes in general, links strategy, planning, and future development of the organization and defines strategic planning as the integration of an organisation’s major goals, policies, and actions into a cohesive whole. Puffitt *et al.* (1992) define strategic planning as a set of actions organised to achieve, over a period of time, specific desired objectives derived from a precise analysis of available information expected to affect the organization, such as its strengths and weaknesses, and which will move the organisation from where it is now to where it wants to be.

According to Balaban *et al.* (2018), Jeladze & Pata (2018) organisational strategies should be developed by management teams to enhance digital capacity, ensure scale and sustainability. The concept of strategy underpins strategic planning (Bell, 2002). It has been argued that the development of strategy in schools is a key management process that brings together institutional values and goals and provides a framework for the quality of provision and the use of resources (Preedy *et al.*, 1997). Likewise, Bell (2022) argues that schools, like other organizations, cannot navigate change without leadership and direction.



However, according to Bell (2002), the risk of traditional strategic planning is that the identification of long-term goals and the only way to achieve them is limited to a small group of senior managers, with the implementation left to the majority who had no part in formulating them. To establish a coherent approach, there must be a consensus on values and acceptable means that are not tied to traditional hierarchical management models, which prioritize rigid rules and function separation. Work relationships should become less hierarchical and more holistic, with power distributed more broadly throughout the organization. Bell (2022) advocates for developing whole-school perspectives, rather than leaving decision-making to a small, senior group of staff. Work relationships must move towards being less hierarchical, more multifunctional and holistic based on a wider distribution of power within the organisation. Whole school perspectives must be developed, as they are too important to be left to a small group of staff, however senior (Bell, 2002). In like vein, (Caneva *et al.*, 2023) show that it is important to empower ICs and include them in the definition of the institution's strategy, especially when digital technologies are involved. It is a question of setting up "co-operation, responsiveness, flexibility and partnership" (Bell, 2002).

## Training educational leaders

According to the literature, educational leaders have difficulties in translating and operationalising the introduction of digital technologies in educational institutions and, Ruloff and Petko's (2022) research show they tend to set up uncoordinated actions. One of the reasons is that educational leaders' training programs are often insufficient to prepare them for the demands of the job (Alvoid & Black, 2014). This is especially the case where digital education is concerned. The period of distance learning during COVID showed us the level of unpreparedness of many educational leaders in relation to the use of technology in educational institutions (Caneva & Pulfrey, 2023). According to Hakansson Linkvist (2019), it is a challenge for educational leaders to find time to prioritize leadership for the use of digital technologies. Kamylyis and Punie (2013) also raise concerns regarding educational leaders' low levels of training and competence for promoting and advancing the innovative use of digital technologies in 1:1 initiatives. Educational leaders mostly seem to have little knowledge about the skills a leader needs in the digital age (Cortellazzo, Bruni & Zampieri, 2019). Furthermore, they mostly work alone and feel isolated in the job (Spillane & Lee, 2014), when the research shows the importance of building a network of schools to promote digital education and to facilitate collaborative networks between teachers (Jariego *et al.*, 2023).

## Statement of the problem

With little support from ministries of education, little preparation for digital integration and working in isolation, managing new and complex digital integration projects with all their challenges often seems complicated for educational leaders. As a consequence, they often delegate digital education projects to instructional coaches (IC) who are trained mainly how to teach digital education, but rarely to lead a team, to manage a project or to operationalize a strategy (Caneva *et al.*, 2023; Wise, 2021). Educational leaders tend to delegate without really getting involved (Caneva *et al.*, 2023), which means their establishments miss out on collaborative idea generation processes because the structures needed to bring diverse staff across the organization together are missing (Petrucci & Riviera, 2018). The co-generation of ideas and knowledge cultivates stronger relationships and facilitate innovation processes (Henttonen *et al.*, 2012).

Given that in educational institutions neither educational leaders nor ICs are fully equipped to lead the development of the digital capacity of their schools (Caneva *et al.*, 2023), the purpose of this study is twofold. First, it aims to identify key factors which the educational leaders believe are linked to the development of the digital capacity of an institution. Second, it aims to identify the obstacles they face to develop their school digital capacity.



**RQ 1. What aspects of educational institutions do leaders perceive to be associated with the digital capacity?**

**RQ 2. What do they think they need to do to develop educational institutions' digital capacity? What obstacles do they face?**

The answers to these questions will enable us to understand their actions, the motivations behind their choices to develop the digital capacity of their educational institutions, the difficulties they encountered and how they overcame them. This will allow training institutions to better understand how to train them to manage these reforms effectively, and ministries of education to better understand how to support them.

## Methods

A mixed-methods approach with sequential exploratory design was adopted (Warfa, 2016) to develop a comprehensive understanding of the research topic by utilizing the strengths of both qualitative and quantitative methods.

## Context

The digital education project (EduNum) started in 2018 with 12 pilot schools participating in an ongoing large-scale digital education curricular reform in Switzerland, in the administrative region of Vaud. The aim of the pilot was to learn lessons for the roll-out phase to the remaining 81 primary and secondary schools involved in the reform. At the time of our study, 29 schools were involved in the project.

Mandated by the department of education and the result of a collaboration with three universities (Ecole Polytechnique fédérale de Lausanne EPFL, University of Lausanne UNIL and University of Teacher Education HEP Vaud), the reform aims to integrate digital education (intended as computer science, information and communication technologies [ICT] and digital citizenship) at all levels of compulsory education (K-12). All in-service teachers from 93 public schools (approximately 9,900 teachers, concerning 93,000 students) received training to incorporate digital technologies in their teaching practices. The training also focused on teaching computer science and digital citizenship (El-Hamamsy *et al.*, 2021).

## Participants and data collection

A total of 29 educational institutions participated in the research. All management teams received a questionnaire. Out of the 29 schools, 12 principals of a school participating in the pilot phase were also invited to participate in a focus group, as they had been involved in the reform from the beginning and therefore had a deep understanding of its goals and challenges.

Both quantitative and qualitative data were collected between September and October 2021.



## QUESTIONNAIRE DATA COLLECTION

An important step in digital integration in schools is carrying out a digital self-review process, which highlights strengths and weaknesses and can help establish priorities for action (Pedder and Macbeath, 2008). In the quantitative side of this research, we used the SELFIE school self-assessment (Self-reflection on Effective Learning by Fostering the use of Innovative Educational technologies) (<https://schools-go-digital.jrc.ec.europa.eu>), a free tool developed by the European Commission (Kampylis, Punie & Devine, 2015) and based on the European Framework for Digitally Competent Educational Organisations (Kampylis, Punie & Devine, 2015).

Teachers and educational managers from the twenty-nine compulsory schools (primary and secondary) were invited. The invitation was sent to the participants via the cantonal education department. Participation was voluntary and participants could end their participation at any time during the questionnaire. The SELFIE survey tool provides a version for teachers and a version for school management. In this study, we focus only on participants from the educational leadership teams. There were 110 participants (M =66, F = 43, 1 missing), mean age 49.22 (SD = 8.53). School principals constituted 21% of the sample and deans the other 79%. Overall, the average length of time in a leadership position was 3.2 years (SD = 2.42), but ranged from less than a year to 12 years.

Participant opinions were gathered using a psychometrically validated reduced form (Costa, Castano-Munoz & Kampylis, 2021) of the SELFIE online self-reflection tool that measures school member perceptions of the different aspects of schools' digital capacities.

This concise educational leadership version of SELFIE (Costa, Castano-Munoz & Kampylis, 2021) includes 32 items, distributed in seven categories:

- leadership [3 items: e.g.: "In our school, we have a digital strategy",  $\alpha = .70$ ];
- infrastructure and equipment [6 items: e.g.: "In our school, we have internet access for teaching and learning,"  $\alpha = .80$ ];
- continuing professional development [3 items: e.g.: "Our teachers have the opportunity to participate in further education on teaching and learning with digital technology",  $\alpha = .62$ ];
- teaching and learning—support [4 items: e.g.: "our teachers create digital learning resources for my classes",  $\alpha = .71$ ];
- teaching and learning—pedagogy [5 items: e.g.: "Our teachers use digital technology to encourage pupil creativity",  $\alpha = .89$ ];
- assessment practices [4 items: e.g.: "I use digital technology to provide timely feedback to my pupils",  $\alpha = .85$ ];
- pupils [6 items: e.g.: "In our school, pupils learn how to adopt safe behavior when online",  $\alpha = .88$ ].

One additional question concerned time, "In our school teachers have time to seek how to improve their teaching with digital technology". The final question of this section of the questionnaire consisted of a question gauging each respondent's opinion of the digital collective efficacy of their school by asking for the degree of agreement with the statement: "In general, our school has a good level of collective digital efficacy (Pulfrey & Caneva, 2023). For all the above questions, the answer scale was 1: Strongly disagree; 2: Disagree; 3: Slightly agree; 4: Agree; 5: Strongly agree.



## FOCUS GROUP DATA COLLECTION

Following the completion of the questionnaire, 12 principals (M=9, F=3) were invited to participate in a one-hour focus group to elaborate on the main findings of the quantitative analysis and to answer the second research question. We asked four open-ended questions, which were also included in the SELFIE questionnaire, relating to their leadership and the development of a digital strategy for their school, the equipment, the professional development activities carried out in the school for teachers, and the obstacles encountered.

## Data analysis

### QUESTIONNAIRE: STATISTICAL ANALYSIS

In order to answer our research question from a quantitative perspective and find out what aspects of schools that educational leaders perceived to be associated with school digital competence, we used the STATA `meglm`, multilevel mixed effects generalized linear model package as this allowed us to control for random effects at the school level. The robust standard error option [`vce (robust)`] makes it possible to control for variability in distribution of standard errors.

We firstly tested associations between leader perceptions of core school-level dimensions (leadership, learning support, infrastructure, teacher use of digital resources in and out of the classroom) and their assessment of overall school digital efficacy. We then fine-tuned the analysis, breaking down the core dimensions and testing associations between the individual items in the core dimensions and the dependent variable. In a third set of analyses, we tested the relationship between school-level dimensions, leadership, learning support, infrastructure, and teacher use of digital resources in the classroom, as perceived by the educational leaders. In all regression models we controlled for leadership position, gender, age and years of experience in an educational leadership position.

### FOCUS GROUP: THEMATIC ANALYSIS

We used thematic analysis, “[...] a method for identifying, analysing and reporting patterns (themes) within data” (Braun & Clarke, 2006, p. 79).

Firstly, we transcribed the recordings of the focus groups. In a second step, we identified the main categories to answer the research questions. We assigned each response or excerpt from the transcription to one or more categories.

The categories and corresponding excerpts were then compared, discussed, and grouped until we agreed on the codebook we had created together. The process of coding the excerpt was iterative, so that the initial sets of inductive categories were adjusted as we went through the responses. Each node (i.e. a collection of references on a particular topic) was further refined by analysing the material coded within it to ensure a coherent coding criterion throughout the process. We merged, renamed, and adjusted the initial categories to ensure coherence between the coded material and the set of nodes; and to ensure that all data were covered. Finally, as the emerging categories were not mutually exclusive, the same extracts may have been assigned to more than one category.

Three major themes emerged: defining the strategy, obstacles, and facilitators. The “strategy definition” theme is made up of five sub-themes: obtaining Wi-Fi, obtaining technological equipment, organizing human resources, implementing teachers’ professional development, changing the educational paradigm.





The second theme, obstacles, is made up of eight sub-themes: lack of knowledge of educational leaders in managing a digital curriculum reform at school level, lack of technical knowledge of ICs, infrastructure problems, lack of budget for HR, unclear role of actors involved in digital curriculum reform, difficult integration of digital technologies in school management, teachers not participating in professional development activities, decreased motivation of teachers in relation to digital curriculum reform over time, the different levels of use of digital technologies for educational purposes among teachers, lack of time.

Regarding the facilitating factors, we identified two sub-themes: bottom-up approach, positive impact of school closure during the COVID pandemic on the use of digital technologies by teachers.

To ensure that the coding is reliable, the two researchers conducting the study (the authors) independently coded all excerpts through NVivo 12; inter-rater reliability was calculated on the agreement rate. The obtained rate of 0.88 for inter-rater reliability is regarded as satisfactory, according to Multon & Coleman (2018).

## Results

The following section is organized according to the research questions.

### RQ 1. What aspects of schools do educational leaders perceive to be associated with school digital competence?

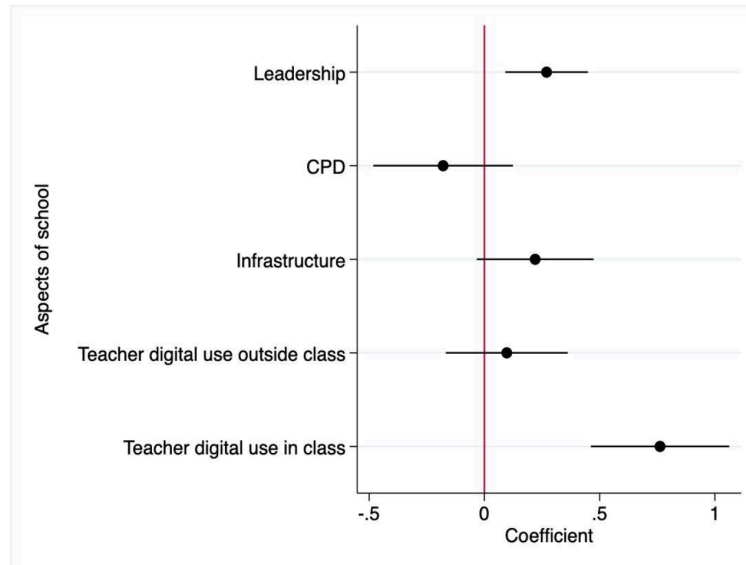
#### STRATEGY AND TEACHING COUNT

Quantitative results reveal that educational leaders were aware of the importance of their role in the development of school digital efficacy. Notably, perceptions of digital efficacy in the school were positively associated with leadership factors,  $B = 0.27$ ,  $SE = 0.09$ ,  $Z = 2.90$ ,  $p < .01$ ,  $\eta^2 = .09$ , 95% CI [0.09, 0.45]. Perceived digital efficacy was also associated with the degree to which educational leaders' perceived teachers to be using digital technology in the classroom,  $B = 0.76$ ,  $SE = 0.13$ ,  $Z = 5.68$ ,  $p < .001$ ,  $\eta^2 = .22$ , 95% CI [0.50, 1.02]. Results are presented in Figure 1.



**Figure 1**

*Regression coefficients showing associations between core factors in school and school-level digital efficacy as perceived by educational leadership (horizontal lines = confidence intervals)*



#### STRATEGY, EQUIPMENT, TRAINING, AND DIGITAL USE IN THE CLASSROOM

As leadership, pedagogy, infrastructure and CPD are all large, composite dimensions, we re-ran the above analysis including the individual items of these dimensions, to obtain a more fine-tuned understanding of what specific factors within them might be key areas of impact.

Results show that, in terms of leadership factors, the belief that there was a digital strategy in place was the only factor associated with school digital efficacy perceptions,  $B = 0.24$ ,  $SE = 0.10$ ,  $Z = 2.43$ ,  $p < .05$ ,  $\eta^2 = .09$ , 95% CI [0.05, 0.44].

In terms of CPD, beliefs that the teachers had the opportunity to participate in digital skills further education training was related to digital efficacy beliefs,  $B = 0.22$ ,  $SE = 0.11$ ,  $Z = 2.07$ ,  $p < .05$ ,  $\eta^2 = .09$ , 95% CI [0.01, 0.45].

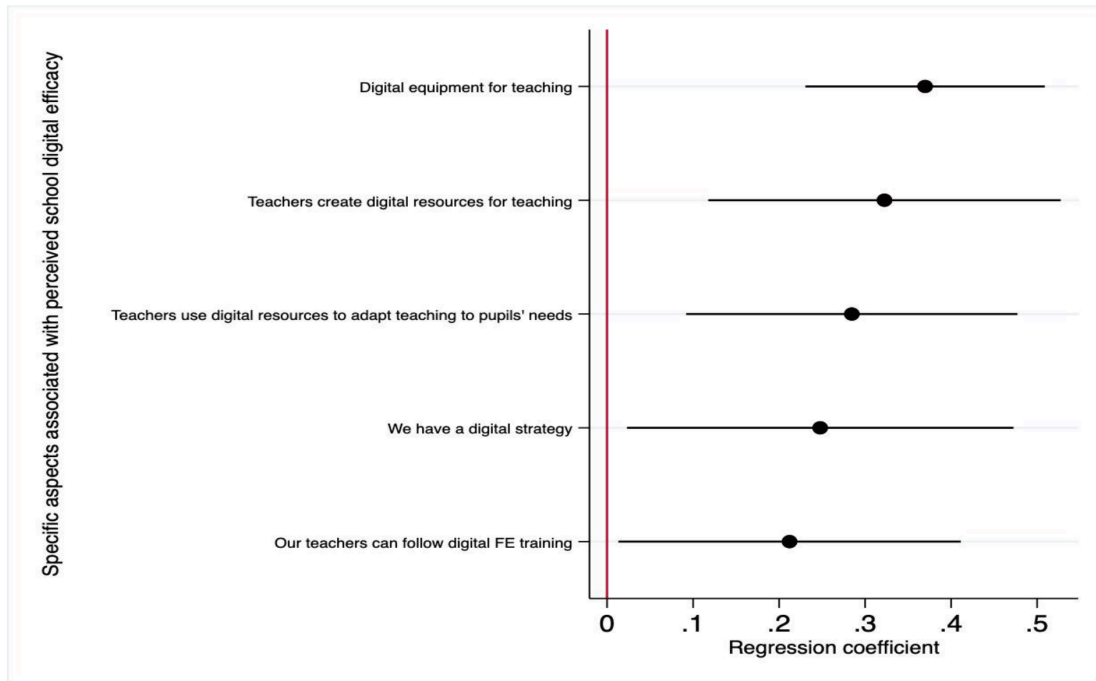
An infrastructure-related factor positively associated with digital efficacy in the school was the belief that teachers were equipped with digital equipment for teaching,  $B = 0.37$ ,  $SE = 0.08$ ,  $Z = 4.97$ ,  $p < .001$ ,  $\eta^2 = .09$ , 95% CI [0.23, 0.52].

Finally, educational leaders' perceptions of school digital efficacy were also related to the degree to which they perceived teachers to be using digital technology for more sophisticated activities, such as creating digital resources for their teaching,  $B = 0.32$ ,  $SE = 0.11$ ,  $Z = 2.92$ ,  $p < .01$ ,  $\eta^2 = .09$ , 95% CI [0.10, 0.53]. and using digital resources to adapt their teaching to the varying needs of their pupils,  $B = 0.32$ ,  $SE = 0.10$ ,  $Z = 3.28$ ,  $p < .01$ ,  $\eta^2 = .09$ , 95% CI [0.13, 0.51]. Significant results are presented below in Figure 2.



**Figure 2**

*Regression coefficients showing associations between specific factors in school and school-level digital efficacy as perceived by educational leadership (horizontal lines = confidence intervals)*



### STRATEGY AND EQUIPMENT ARE ALSO IMPORTANT FOR TEACHER ADOPTION IN THE CLASSROOM

As teacher classroom digital activities were considered important aspects of school digital competence by educational leaders, we examined what school level factors among leadership, training and infrastructure were associated with teacher use of digital resources in the classroom. Results of the same regression modelling approach with teacher use of digital resources in the classroom as dependent variable revealed once again that having a digital strategy was a core predictor of teacher use,  $B = 0.18$ ,  $SE = 0.07$ ,  $Z = 2.51$ ,  $p < .05$ ,  $\eta^2 = .09$ , 95% CI [0.04, 0.32] as was the availability of equipment for teacher and pupil use,  $B = 0.20$ ,  $SE = 0.07$ ,  $Z = 2.69$ ,  $p < .01$ ,  $\eta^2 = .09$ , 95% CI [0.05, 0.34].

### CONCLUSIONS FROM QUANTITATIVE DATA

Results of the quantitative analyses clearly indicate the importance educational leadership teams attach to having a strategy. In their view, strategy is clearly associated with general school-level digital efficacy, and teacher use of digital tools in the classroom.

However, what is less clear is the content of the all-important digital strategy. What actions should leadership be taking to evolve digital efficacy in their schools, what challenges might they face and how can they overcome these? What role does teacher training, human and technical infrastructure and specific leadership behavior play in the successful development of a school's digital efficacy? To answer these questions, we enrich our quantitative findings with qualitative investigations carried out by means of a focus group discussion with leaders of all twelve schools involved in the pilot scheme.



## RQ 2-1. What do educational leaders think they need to do to develop school digital capacity?

Results of the focus group discussions show that principals recognize the importance of their leadership and of having a digital strategy, but the components of the latter are not unanimously shared. They are implementing multiple actions that are not systematically coordinated. Each principal seems to have a different interpretation of what the digital strategy should include and the weight or priority of each of these actions.

### ORGANISATION OF TEACHERS' PROFESSIONAL DEVELOPMENT (PD)

Almost half of the excerpts of the focus group (40%, 74) concerned the organisation of teachers' PD within the school. Its implementation varies between schools and oscillates between formal and informal PD activities, activities that IC offers to teachers individually or in groups. The activities do not always seem to be coordinated:

“We have training during the ‘pedagogical day’ (...). Then we have training for groups of teachers. We offer them on a voluntary basis and people come who are interested. (...) Then there is individual training for a teacher who wants to be trained in something more specific. (...) The last aspect of our training strategy is peer training.” (Principal 8)

Although Principal 8 explains that there are a variety of ways in which PD activities are offered in his school, it is not clear how the choice of these different modalities is made, both from the ICs and the teacher's perspective. Principal 8 does not explain the overall goal to be achieved in terms of PD: actions are taken but the objectives are unclear. At the same time, he talks about the importance of

“giving an impetus, a vision, communicating around it and then showing very clearly where the management wants to go.” (Principal 8)

Only one participant (Principal 7) highlights the importance of “setting up an IC team” to improve teachers' training (...)” and of wanting to “bring out objectives.” She adds that IC competences were the basis for offering PD activities to teachers:

“To develop the whole training offer ... first we mapped all the ICs to understand their skills and interests.” (Principal 7)

In general, teachers' training needs are not mentioned and do not seem to be taken into consideration when proposing PD activities.

### ORGANISING HUMAN RESOURCES (HR) AND DELEGATING DIGITAL EDUCATION REFORM TO IC

Almost half of the extracts (39%, 28) concerned the organisation of HR and (25%, 19) the delegation to IC of the operationalisation of the implementation of digital educational reform in the school. To this end, the principals mentioned a range of different approaches.



One principal said that he delegates “the whole organisation of the project” to the IC (6). On the other hand, another (7) recognizes that to delegate digital implementation to ICs, ICs need to have several skills that go beyond the knowledge of digital education:

“For me, it’s important that the IC wears two hats to manage a team. It’s not just about running meetings, it’s much more than that. It is about managing the teams by bringing out the strengths and weaknesses of the team so that they can then go on to deliver services.” (Principal 7)

Principal 2 confirmed this, stressing that he preferred not to overburden either the technicians or the deans and so relies on the IC team to manage digital development:

“The strategy for me is not to use management resources, because we have enough work already, and not necessarily to use technical resources (...) So I sent all this directly to the ICs.” (Principal 2)

Principal 1 takes a completely different approach, employing someone with a technical profile to manage the digital project:

“At the beginning of the school year I hired someone who is not a teacher and who has a technical profile to manage a project (...) I hired a project manager.” (Principal 1)

Finally, Principal 2 adds that the fact that different people with similar roles are involved in the project leads to the need for a clarification of the different tasks:

“In my strategy, it is necessary to clearly differentiate the tasks of the IT managers, the IC, in a better way than we have done so far.” (Principal 2)

#### OBTAINING THE EQUIPMENT AND WI-FI

These are prerequisites for the implementation of the reform and are therefore under-represented, with only 8% (6) of excerpts relating to the acquisition of technical equipment and 7% (5) of excerpts relating to the acquisition of Wi-Fi.

“We started with three axes. The first was material. I was in charge of the negotiations with the municipalities. (Principal 2)

“The first strategy I had when I signed up for the pilot was to have Wi-Fi.” (Principal 1)

#### CHANGING THE PEDAGOGICAL APPROACH

Only 4% (3) of the excerpts concerned the pedagogical approach. One principal mentioned pedagogy and the need to rethink it:

“I have the impression that teachers are still doing exactly the same thing as when I was at school, which horrifies me.” (Principal 8)

In conclusion, the focus group participants only mentioned the actions of their strategy (organising the PD, organising the HR, getting the equipment, getting the Wi-Fi), but no one tied this into an overall strategy and no mention was made of the vision, or the end goal.



## RQ 2-2. What obstacles do they face?

### LACK OF BUDGET FOR HR

Almost one in four coded extracts (21%, 15) referred to the need to recruit more staff, or at least to retain those involved in the pilot phase in the roll-out, particularly ICs and technicians, to help with the implementation of the project.

### TEACHERS ARE NOT TAKING PART IN THE SCHOOL'S PD ACTIVITIES

Fourteen percent (10) of the extracts mentioned that non-compulsory professional development activities have the disadvantage of reaching only a small proportion of teachers. For example, principal 7 said:

“People don't necessarily sign up, they are busy with other things”. (Principal 7)

### INEQUALITIES IN TEACHERS' DIGITAL SKILLS

Fourteen percent (10) of the excerpts mentioned the digital divide between teachers. For example, principal 5 said:

“We know that they are all at different levels, they are in different positions.” (Principal 5)

### LACK OF KNOWLEDGE ABOUT HOW TO IMPLEMENT AND MONITOR THE PROGRESS OF DIGITAL EDUCATION IN A SCHOOL

Seven percent (5) of the extracts mentioned the lack of knowledge of educational leaders on how to implement digital education in a school and how to monitor its progress:

What do we put in place? A dashboard to really have a good vision of everything that is being delivered to students and teachers? We all know what a dashboard is, we've all learnt it, but it takes a lot of time to set up indicators, especially in relation to SELFIE, now that we have it. So, we have problems with this dimension, what are the indicators we are going to set up? Then I think there is a lack of support to go that far in monitoring. I know they (the IC) are doing a lot of things (...) but I haven't found the best way to monitor it yet. (Principal 7)

And the feeling of not being competent

I personally have absolutely no time to create a dashboard, to develop it and to monitor it (...). If the headteacher, who I am, is expected to manage this project, it will be ruined in my school (...) It is clear to me that I can't do it and I think we are wrong to think that it is up to the headteacher to manage this project. I can't do it, I don't agree with it and that's what worries me because I have the impression that there is a shift. We have set aside periods to delegate this mission to competent people, the ICs. I'm not competent. It's not my job. (Principal 6)

So, of course, I can ask for accounts, I can ask for reports, I can request the daily schedule, how they are going to invest their time. But it's clear that I don't have the skills to judge the merits of their investment in practice and in time. That's not my job. (Principal 6)



## Discussion

In this study, we explored the perceptions of educational leaders on the factors and actions that influence the digital capacity of their schools, using a mixed-methods approach. We found that leadership and a clear strategy were perceived as key elements for improving the digital efficacy of the school and the teacher use of digital technologies. However, we also observed a lack of coherence and consistency in the actions taken by the principals to implement the digital reform, which resulted in suboptimal outcomes. Our findings are consistent with previous studies that highlighted the importance of leadership and strategic planning for successful digital integration (Pulfrey & Caneva, 2023; Eickelmann, 2011; Puffitt *et al.*, 1992; Quinn, 1980).

### The importance of leadership and of a clear strategy for improving the digital capacity of the school

Our quantitative data showed that participating educational leaders believed that their role as leaders was significantly associated with improved digital efficacy in the school as well as teacher use of digital technology. This is in line with the literature that emphasizes the pivotal role of principals in fostering a culture of innovation and change in their schools (Pulfrey & Caneva, 2023; Eickelmann, 2011; Trotty-Aubrey, 2019). Moreover, they saw a link between having a digital strategy and collective digital efficacy in the school. A digital strategy is a document that outlines the vision, goals, actions, and indicators for enhancing the digital capacity of the school (Puffitt *et al.*, 1992). It provides a clear direction and a common framework for all the stakeholders involved in the digital reform. According to Quinn (1980), having a coherent strategy is essential for aligning the resources and efforts of the organization towards a shared purpose. However, our qualitative data revealed that most of the principals did not have a well-defined digital strategy for their schools, which hindered their ability to effectively lead and manage the digital integration process. This finding suggests that there is a need for more guidance and support for educational leaders in developing and implementing digital strategies for their schools.

### Many actions, but no coherent strategy

Although the quantitative data show that leadership and a coherent strategy are crucial factors according to the principals to improve the digital capacity of an institution, aligning with the findings of Pulfrey & Caneva (2023), the qualitative data highlight their difficulty in determining a concrete strategy with clearly defined steps, vision, objectives, indicators, initial diagnosis, and final assessment, which are key elements (Puffitt *et al.*, 1992). This indicates a gap between the principals' beliefs and their practices, which may affect their credibility and effectiveness as leaders. Furthermore, the lack of a clear strategy may lead to confusion and inconsistency among the teachers and other staff members, who may not understand the rationale and the expectations of the digital education project.

To make progress in executing the digital education project in their schools, principals have taken several actions and solved problems related to infrastructure and equipment, which is a prerequisite, as also evidenced by Kampylis & Sala (2023). However, these actions are not sufficient to ensure a sustainable and meaningful integration of digital technologies in the teaching and learning process. As Eickelmann (2011) argues, infrastructure and equipment are only the basic conditions, but not the driving forces. Therefore, more attention should be paid to the pedagogical and organizational aspects of the digital education project, such as the curriculum, the assessment, the collaboration, and the innovation culture.



Some of the principals have refined the roles of ICs and technical staff, which also emerged as an important issue to be addressed in the research by Trotty-Aubrey (2019) and Caneva, Monnier, Pulfrey, El Hamamsy & Delher Zufferey (2023). ICs are teachers who have received specific training and have the responsibility to support their colleagues in using digital technologies in their classrooms. Technical staff are in charge of maintaining and troubleshooting the digital devices and systems in the school. The principals recognized the value and the challenges of these roles, and tried to provide them with more autonomy, recognition, and resources. However, some of the ICs and technical staff reported feeling overwhelmed and isolated by their tasks, and expressed the need for more collaboration and communication with the principals and among themselves. This suggests that there is room for improvement in the management and coordination of these roles, as well as in the professional development and support for the ICs and technical staff.

## Lacking HR resources

Compared to other research which shows that the main barrier for schools' digital transformation is inadequate or poorly functioning infrastructure (Kampylis & Sala, 2023), the participants mention the lack of a budget to take on more staff to implement the project and accompany the teachers, which is also highlighted by Kampylis & Sala (2023). This implies that the principals are under-resourced and overburdened by the demands and expectations of the digital education project, which may affect their motivation and performance. Moreover, the lack of staff may limit the opportunities and the quality of the support and the feedback that the teachers receive, which are essential for their professional growth and development (Caneva *et al.*, 2023). Therefore, we suggest that the principals should advocate for more human resources from the authorities and the stakeholders, and explore alternative ways of mobilizing and utilizing the existing human resources in their schools, such as creating peer networks, mentoring programs, and collaborative projects among the teachers and the ICs.

## Lack of knowledge about digital education and how to implement it in a school

The results show that educational leaders do not have enough information or skills about the use of technology in education and how to effectively integrate it into their schools' curriculum and operations, as also reported by Ruloff & Petko (2022). This may be a problem as technology is becoming increasingly important in education, and lack of knowledge may hinder schools from fully utilizing its potential benefits. For instance, the principals may not be able to select and evaluate the appropriate digital tools and resources for their schools, to monitor and analyze the data and the outcomes of the digital education project, and to provide effective guidance and feedback to the teachers and the students. As a solution they delegate to the ICs the implementation of the reform in their schools. If, on the one hand, IC have a good understanding of what digital technologies can do for education (Caneva *et al.*, 2023) on the other hand, they generally do not receive training in project or team management, which is at the heart of their work, as one principal points out. This is a major problem form the implementation and perennity of the reform, as suggested by Caneva *et al.* (2023).

The disadvantage of this delegation is that some principals do not know exactly what is done by ICs with teachers and by teachers with students. Although we only invited principals to the focus group, several came with their ICs, to make sure, as some of them told us, that they could answer the researchers' questions about the teachers' professional development. This indicates a lack of communication and collaboration between the principals and the ICs, which may result in a loss of vision and direction for the digital reform. Moreover, the principals may not be able to support and empower the ICs in their roles, and to recognize and appreciate their efforts and achievements.





If principals need to improve digital technology skills, ICs should develop projects and people management skills to be able to work together in identifying the objectives to be achieved and the measures to achieve them. Results of Ugur & Koç, 2019, also show that principals themselves think that they should participate in technology professional development to stay informed and to lead their schools. Therefore, we recommend that the principals and the ICs should engage in continuous and collaborative learning, both within and outside their schools, to enhance their knowledge and skills in digital education and leadership. They should also seek and share best practices and experiences with other educational leaders and experts, and participate in professional networks and communities of practice, such as the ones proposed by Kampylis & Sala (2023).

## An inefficient PD offer

The fact that teachers do not participate in the PD activities that ICs set up for them in school is a problem that is also highlighted by Caneva *et al.* (2023). We have seen that there is no analysis of the training needs of teachers, but rather the approach is to start from the competences and preferences of the ICs. While this is certainly important, we believe that to motivate teachers to participate in PD activities, it is important to offer training that is as personalised as possible, as also highlighted by Ottenbreit-Leftwich *et al.* (2020) and based on the principles of active learning and coherence (Desimone & Pak, 2017). This means that the PD activities should be tailored to the specific needs, interests, and goals of the teachers, and should be aligned with the curriculum, the standards, and the school vision. Moreover, the PD activities should be interactive and engaging, and should provide opportunities for the teachers to apply what they learn in their own contexts, to reflect on their practices, and to receive feedback and support from their peers and mentors.

Our participants mention the difference in level between teachers as a major obstacle, which is also highlighted by Kampylis & Sala (2023). The fact that they do not participate may also be due to the fact that what is offered does not correspond to their level. This suggests that the PD activities are not differentiated and adapted to the diverse needs and abilities of the teachers, which may result in frustration and dissatisfaction. Therefore, we suggest that the principals and the ICs should conduct a thorough and regular assessment of the teachers' digital competence and confidence, using tools such as the European Framework for the Digital Competence of Educators (DigCompEdu) (Redecker & Punie, 2017), and design and deliver PD activities that are suitable and relevant for different levels of proficiency and experience. They should also provide multiple and flexible options and pathways for the teachers to access and participate in the PD activities, such as online, blended, or face-to-face modes, synchronous or asynchronous formats, individual or group settings, and formal or informal learning opportunities.

## Little support from the Ministry of Education to the principals and little networking

Our participants seem to have little support from their superiors and little information to guide them towards a clear vision and objectives. This is also confirmed in the study of Kampylis & Sala (2023). The fact that the principals feel isolated and unsupported by the system may affect their morale and commitment. Moreover, the lack of support and information may prevent them from accessing and benefiting from the latest research, innovations, and policies in digital education, and from learning from the successes and challenges of other schools and educational leaders.



Principals seem to work in isolation. It seems to be evident from the fact that although they are all involved in the same reform, they do not seem to talk to each other to share what they are implementing and what seems to be working or not. This indicates a lack of networking and collaboration among the principals, which may limit their opportunities and resources for learning and improvement. Therefore, we recommend that the ministries of education should provide more guidance and support to the principals, such as clear and consistent policies and standards, adequate and sustainable resources, regular and constructive feedback and evaluation, and recognition and rewards for their efforts and achievements. They should also facilitate and encourage the networking and collaboration among the principals, such as creating and maintaining online platforms and forums, organizing and sponsoring events and conferences, and supporting and promoting professional associations and networks. The literature mentions the importance of building a network of schools (Jariego *et al.*, 2023).

## Limitations and future studies

First, the study focused on the perceptions of educational leaders in one region of one country, which may limit the generalisability of the findings. Second, the study relied on self-reported data from participants, which may have introduced bias or social desirability effects. Finally, the study did not explore the role of other stakeholders, such as teachers and students. Therefore, future studies could address these limitations to improve our understanding of the implementation of digital education reform and the improvement of schools' digital capacity.

## Conclusion and implications

Principals know that leadership is important in leading a digital education reform, but as some feel that they are not competent enough in digital education and its educational potential, they prefer to delegate the implementation of the reform to ICs. As a result, ICs find themselves managing projects and teams when they have little or no management skills. In addition, the lack of a clear vision of what needs to be achieved at the level of the institution results in many disparate actions being carried out, using time and resources in an uncoordinated way. Based on these findings, we recommend clarifying roles and responsibilities at the level of the ministry or department responsible for the reform, the school directorates, and the ICs, in terms of the scope for defining a vision and the actions to be taken to achieve it. We also recommend training for educational leaders to develop a basic knowledge of digital education to increase their sense of competence and to be able to manage the strategic aspect of the reform with the IC. Similarly, we recommend training for ICs to strengthen their project and team management skills.

Finally, we recommend providing resources and training to both educational leaders and the IC on how to develop a digital strategy together and how to operationalise it by having defined objectives, indicators and a plan to monitor its progress and adjustments.



## References

- Agélii Genlott, A., Grönlund, Å., Viberg, O., & Andersson, A. (2021). Leading dissemination of digital, science-based innovation in school—a case study. *Interactive Learning Environments*, 31(7), 4171-4181.
- Alvoid, L., & Black Jr, W. L. (2014). The Changing Role of the Principal: How High-Achieving Districts Are Recalibrating Educational leadership. Center for American Progress.
- Balaban, I., Redjep, N. B., & Calopa, M. K. (2018). The analysis of digital maturity of schools in Croatia. *International Journal of Emerging Technologies in Learning*, 13(6), 4–15. <https://doi.org/10.3991/ijet.v13i06.7844>
- Bell, L. (2002). “Strategic planning and school management: full of sound and fury, signifying nothing?”, *Journal of Educational Administration*, 40(5), 407–424. <https://doi.org/10.1108/09578230210440276>
- Bocconi, S., Kampylis, P., & Punie, Y. (2013). Framing ICT-enabled Innovation for Learning: the case of one-to-one learning initiatives in Europe. *European Journal of Education*, 48(1), 113-130.
- Bourgeois, A., Birch, P., & Davydovskaia, O. (2019). *Digital Education at School in Europe. Eurydice Report*. Education, Audiovisual and Culture Executive Agency, European Commission. Available from EU Bookshop.
- Braun, V. and Clarke, V. (2006). Using thematic analysis in psychology, *Qualitative Research in Psychology*, 3(2), pp. 77–101.
- Caneva, C. & Brabant, C. (2023). *Développer la stratégie numérique de votre établissement d'enseignement. Un guide en 5 étapes*. Presses de l'Université du Québec.
- Caneva, C., Monnier, E., Pulfrey, C., El-Hamamsy, L., Avry, S., & Delher Zufferey, J. D. (2023). Technology integration needs empowered instructional coaches: accompanying in-service teachers in school digitalization. *International Journal of Mentoring and Coaching in Education*, 12(2), 194-215.
- Carvalho, M., Cabral, I., Verdasca, J., & Alves, J. M. (2021). Strategy and Strategic Leadership in Education: A Scoping Review. *Frontiers in Education*, 6. <https://doi.org/10.3389/feduc.2021.706608>
- Cortellazzo, L., Bruni, E. & Zampieri, R. (2019). The Role of Leadership in a Digitalized World: A Review. *Front. Psychol.* 10:1938. <https://doi.org/10.3389/fpsyg.2019.01938>
- Costa, P., Castano-Munoz, J., & Kampylis, P. (2021). Capturing schools' digital capacity: Psychometric analyses of the SELFIE self-reflection tool. *Computers & Education*, 162. <https://doi.org/10.1016/j.compedu.2020.104080>
- Davies, B., & Davies, B. J. (2010). Talent management in academies. *International Journal of Educational Management*, 24(5), 418-426.
- Desimone, L. M., & Pak, K. (2017). Instructional coaching as high-quality professional development. *Theory into practice*, 56(1), 3-12.
- El-Hamamsy, L., Chessel-Lazarotto, F., Bruno, B., Roy, D., Cahlikova, T., Chevalier, M., Parriaux, G., Pellet, J.P., Lanarès, J., Dehler Zufferey, J. & Mondada, F. (2021). A computer science and robotics integration model for primary school: evaluation of a large-scale in-service K-4 teacher-training program. *Education and Information Technologies*, 26, 2445-2475.
- Eickelmann, B. (2011). Supportive and hindering factors to a sustainable implementation of ICT in schools. *Journal for educational research online*, 3(1), 75-103.
- European Commission (2020). *Digital education action plan (2021-2027)*. <https://education.ec.europa.eu/focus-topics/digital-education/action-plan>
- Gerth, A. B., & Peppard, J. (2016). The dynamics of CIO derailment: how CIOs come undone and how to avoid it. *Business Horizons* 59, 61–70. <https://doi.org/10.1016/j.bushor.2015.09.001>
- Gheni, A. Y., Jusoh, Y. Y., Jabar, M. A., Ali, N. M., Abdullah, R. H., Abdullah, S., et Khalefa, M.S. (2016). The virtual teams: E-leaders challenges. In *Proceedings of the IEEE Conference on E-Learning, e-Management and e-Services*, IC3e 2015, 38–42. (Melaka).
- Håkansson Lindqvist, M. (2019). School leaders' practices for innovative use of digital technologies in schools. *British Journal of Educational Technology*, 50(3), 1226-1240. <https://doi.org/10.1111/bjet.12782>
- Henttonen, K., Pussinen, P., & Koivumäki, T. (2012). Managerial perspective on open source collaboration and networked innovation. *Journal of technology management & innovation*, 7(3), 135-147.





- Ismail, S. N., Omar, M. N., & Raman, A. (2021). The authority of principals' technology leadership in empowering teachers' self-efficacy towards ICT use. *International Journal of Evaluation and Research in Education (IJERE)*, 10(3), 878–885. <https://doi.org/10.11591/ijere.v10i3.21816>
- Jariego, I. M., Ramos, D. H., Soriano, F. S., Villar-Onrubia, D., Cachia, R., Herrero, C., & Giannoutsou, N. (2023). Teachers' personal network analysis reveals two types of pioneers in educational digitization: formal and informal intermediaries at schools. *Computers and Education Open*, 100,137. <https://doi.org/10.1016/j.caeo.2023.100137>
- Jeladze, E., & Pata, K. (2018). Smart, digitally enhanced learning ecosystems: Bottlenecks to sustainability in Georgia. *Sustainability*, 10(8), 1–19. <https://doi.org/10.3390/su10082672>
- Kampylis, P. & Sala, S. (2023). Improving the digital capacity of schools by using the SELFIE tool for collective reflection. *European Journal of Education*. <https://doi.org/10.1111/ejed.12561>
- Kampylis, P., Punie, Y., & Devine, J. (2015). *Promoting effective digital-age learning - A European framework for digitally-competent educational organisations*. European Commission Joint Research Centre.
- Kirkland, R. (2014). Artificial intelligence meets the C-suite. *McKinsey Quarterly*.
- Liljenberg, M. (2015). Distributing leadership to establish developing and learning school organisations in the Swedish context. *Educational Management Administration & Leadership*, 43(1), 152-170.
- Multon, K. D., & Coleman, J. S. M. (2018). Inter-rater reliability. In B. B. Frey (Ed.), *The SAGE encyclopedia of educational research, measurement, and evaluation* (pp. 862–865). SAGE Publications.
- OECD. (2015). *Students, computers and learning: making the connection, PISA series*. Paris: OECD Publishing.
- Ottenbreit-Leftwich, A., Liao, Y. C., Karlin, M., Lu, Y. H., Ding, A. C. E., & Guo, M. (2020). Year-long implementation of a research-based technology integration professional development coaching model in an elementary school. *Journal of digital learning in teacher education*, 36(4), 206-220. <https://doi.org/10.1080/21532974.2020.1804494>
- Pedder, D., & MacBeath, J. (2008). Organisational learning approaches to school leadership and management: teachers' values and perceptions of practice. *School Effectiveness and School Improvement*, 19(2), 207-224
- Petrucci, T. & Rivera, M. (2018). Leading Growth through the digital Leader. *Journal of Leadership Studies*, 12(3-4). DOI:10.1002/jls.21595
- Preedy, M., Glatter, R. & Levačić, R. (Eds) (1997). *Educational Management; Strategy, Quality and Resources*, Open University Press, Buckingham.
- Puffitt, R., Stoten, B. & Winkley, D. (1992). *Business Planning for Schools*, London, Longman.
- Pulfrey, C. & Caneva, C. (2023). Strategy, support and sharing: Key factors in developing digital competence in schools. [Manuscript submitted for publication].
- Quinn, J. (1980), *Strategies for Change, Logical Incrementalism*, Irwin, Homewood, IL.
- Redecker, C., & Punie, Y. (2017). *European Framework for the Digital Competence of Educators: DigCompEdu*. Luxembourg: Publications Office of the European Union.
- Ruloff, M. & Petko, D. (2022). School principals' educational goals and leadership styles for digital transformation: results from case studies in upper secondary schools. *International Journal of Leadership in Education*, 1–19. <https://doi.org/10.1080/13603124.2021.2014979>
- Spillane, J. P., & Lee, L. C. (2014). Novice school principals' sense of ultimate responsibility: Problems of practice in transitioning to the principal's office. *Educational Administration Quarterly*, 50(3), 431-465.
- Trotty-Aubrey, W. F. (2019). *Educators' perspectives on implementing instructional coaching in an urban secondary science department* [Doctoral dissertation, University of Houston, United States of America].
- Ugur, N. G., & Koç, T. (2019). Leading and Teaching with Technology: School Principals' Perspective. *International Journal of Educational Leadership and Management*, 7(1), 42-71. <https://doi.org/10.17583/ijelm.2019.3758>
- Warfa, A.-R. M. (2016). Mixed-methods design in biology education research: Approach and uses. *CBE—Life Sciences Education*, 15(4). <https://doi.org/10.1187/cbe.16-01-0022>
- Wise, M. (2021). Instructional coach leadership: perceptions of purpose, practices, and supports in coaching for educational equity [Doctoral Dissertation, The Claremont Graduate University, United States of America]. [https://scholarship.claremont.edu/cgu\\_etd/233/](https://scholarship.claremont.edu/cgu_etd/233/)