European Commission

European Expert Network
on Economics of Education

The latest research trends in the field of economics of education: January to June 2024

EENEE Coordination team

PPMi

ABOUT EENEE

EENEE is an advisory network of experts working on economics of education and training. The establishment of the network was initiated by the European Commission's Directorate-General for Education and Culture and is funded by the Erasmus+ Programme. PPMI is responsible for the coordination of the EENEE network. More information on EENEE and its deliverables can be found on the network's website www.eenee.eu. For any inquiries, please contact us at: eenee@ppmi.lt.

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Important themes and issues for future European Commission's work on the economics of education

This document provides a summary of important themes and issues to inspire future European Commission's work in the field of economics of education and training. The summary highlights published research and foresight studies between January and June 2024, that may be relevant for the upcoming Commission's priorities.

Journal selection

In 2024, the list of journals for tracking research trends was reviewed based on established criteria, with a focus on topic coverage, geographical relevance, and quality assurance. This revision aimed to apply a more transparent and systematic method for key journals selection. The final list of consulted platforms includes academic journal articles and publications from international organisations involved in education (e.g. OECD, World Bank, etc.). This revised list was afterwards shared with members of EENEE to seek recommendations and suggestions for additional relevant journals that publish articles related to the social dimensions of education. The following list indicates the sources and number of articles from each source included in the analysis.

Number	Journal/Relevant organisation	Number of articles selected
1	Citizenship, Social and Economics Education	3
2	Econometrica	1
3	Economics of Education Review	17
4	Economies	0
5	Education Economics	6
6	Educational Assessment, Evaluation and Accountability	0
7	Educational Evaluation and Policy Analysis	1
8	International Journal of Educational Research	3
9	Journal of Development Economics	2
10	Journal of Economic Education (JEE)	3
11	Journal of Human Capital	1
12	Journal of Labour Economics	3
13	Journal of Political Economy	2
14	Journal of the European Economic Association	1
15	JRC	1
16	Large scale assessments in education	1
17	OECD	4
18	Quarterly Journal of Economics	0
19	Review of Economic Studies	1
20	Review of Economics and Statistics	1
21	Review of Educational Research	3

22	Teaching and Teacher Education	1
23	The Journal of Human Resources	2
24	The Review of Economic Studies	2
25	UNESCO	1
26	World Bank	1
	Total	61

Optimising article clustering with NLP tools

In our ongoing efforts to enhance the efficiency and objectivity of our research trend-tracking process, we have integrated Natural Language Processing (NLP) tools into our workflow. These tools automate the extraction of relevant themes and keywords from academic publications.

The implementation of these tools has significantly reduced the need for manual review and selection of topics, thereby ensuring a broader and more unbiased approach to identifying emerging research topics. Furthermore, their use has facilitated the recognition of other trends in article characteristics, such as the prioritisation of specific education levels over others.

By employing advanced NLP techniques such as keyword extraction and thematic clustering, our aim is to systematically identify and summarise developments and trends in the field of education and training.

Rationale for using natural language processing

The transition to NLP-based research trends is driven by the need to manage efficiently the vast volume of data generated daily[1]. Traditional methods are time-consuming and prone to human bias, limiting their effectiveness in comprehensive policy analysis[2]. NLP techniques offer systematic processing, enhancing the objectivity and efficiency of data analysis[3]. This shift allows for more accurate insights and better-informed policies, which, in the long term, can feed into foresight analysis to anticipate future scenarios. By leveraging ML and NLP, we aim to improve the quality and relevance of our research trends, ensuring they effectively support the policy development process.

Process

The transition to NLP-based research trends involves a structured framework to ensure comprehensive data analysis and clustering. Our approach follows a two-step methodology: keyword extraction (NLP-based) followed by clustering (ML technique).

1. Keyword extraction is performed using NLP techniques to identify relevant terms from titles and abstracts. This step is crucial as it lays the foundation for subsequent analysis by capturing the essence of the text.

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[1] 396 publications were released in May 2024 on the European Publication website alone.
[2] Nay, J. (2018). Natural Language Processing and Machine Learning for Law and Policy Texts. SSRN Electronic Journal. https://doi.org/10.2139/ssrn.3438276
[3] It is important to note that while NLP techniques can significantly reduce human bias in data processing, they are not free from bias themselves. The algorithms can inadvertently perpetuate existing biases present in the training data. Therefore, integrating a 'human-in-the-loop' approach is crucial to provide oversight and contextual interpretation, helping to mitigate these biases and ensure the quality and relevance of the outputs.

2. Selected keywords are embedded into a vector space and undergo dimensionality reduction to streamline the data. A clustering algorithm (here, HDBSCAN[4]) is then applied to group the keywords into meaningful thematic clusters. This phase helps uncover underlying patterns and trends within the dataset. This process ensures a systematic and objective analysis of large volumes of text, enhancing the efficiency and accuracy of our research trends.

NLP Results

The first implementation of these novel techniques in our research trends analysis is presented below (see Results section). NLP is employed as a powerful tool to detect patterns that are difficult to discern through traditional methods and to understand the large database in novel ways, but it is not meant to replace the expertise of the coordination team, which further refines the NLP clustering and drafts the analytical overview.

This process successfully identified 8 initial clusters (reduced to 6 after analysis). Each final cluster representing a unique thematic area within the dataset. The model revealed the following keywords, as visualised in the accompanying word cloud:
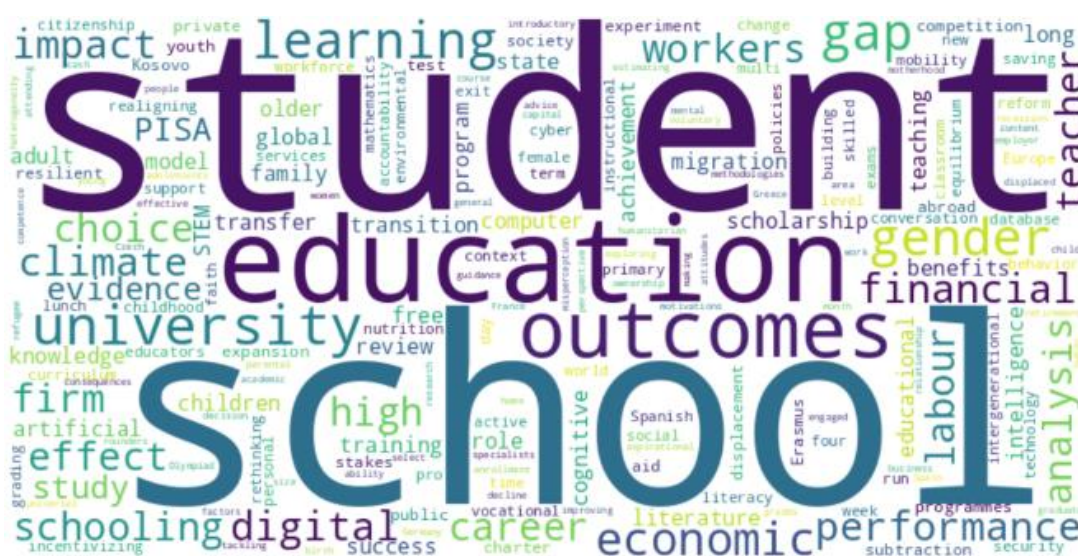
Source: Own creation

The initial implementation of ML and NLP techniques in our research trends analysis demonstrates significant potential in enhancing the objectivity and efficiency of our data processing. This innovative approach is not only a valuable tool for our current project but also holds promise for application in other projects, offering a novel way to analyse and understand large datasets across various fields. The use of NLP represents a forward-thinking step in our research methodology, paving the way for more informed and effective policy development.

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[4] 'HDBSCAN', Scikit-Learn, 2024. https://scikit-learn.org/stable/modules/generated/sklearn.cluster.HDBSCAN.html.

Results

This summary of the most relevant articles from top-ranked journals includes the following major topics:

- Exploring effects on student achievement
- The intersection of education and the labour market
- Gender gaps and educational choices
- Education policies and outcomes
- Education innovation and teacher practices
- Digital education and technological impact

While tracking research trends in the most prominent academic journals and recent foresight studies (see Table 1), **we observed six themes** relevant to the highlighted priorities and broader context of the economics of education and training. The following table also covers specific topics, providing a quick oversight of key research themes developed in the academic journals that have an economic aspect of education (see Table 2).

The report is structured according to the themes indicated in the table. Several articles on each theme are then discussed to give a broader understanding of the issues covered in each theme. Even though some of the studies present evidence from the non-EU countries, may also reflect some of the EU challenges and priorities.

TABLE 1. THE MAIN THEMES DISCOVERED IN THE JOURNALS

THEMES	ARTICLES
Exploring factors affecting student achievement (Cluster 1 and Cluster 2)	– *Factors affecting predictive power of early numeracy skills on achievement in mathematics in primary school* – *After school programmes effect on academic outcomes* – *The effect of background factors on academic achievement and other outcomes (e.g. attendance, graduation, socioemotional development)* – *Academic inequalities between advantaged and less advantaged students and the role of family, ethnicity, and race* – *The effect of US policies on students' academic achievement* – *The use of assessment data to study influential factors on student achievement* – *The impact of Erasmus mobility programme on student performance in Europe*
The intersection between education and the labour market (Cluster 3 and Cluster 5)	– *University admission policies in relation to the labour market outcomes* – *University to work transitions (the role of work experience, migration and skills development)* – *Adult Education and retirement reforms* – *Challenges in European job markets (e.g. skills shortages across the EU, new employment patterns)*
Gender gaps and educational choices (Cluster 4)	– *The role of teaching practices on gender gaps in Mathematics* – *The gender gap in secondary level economic and business courses.* – *Factors influencing the gender gap in STEM fields in Higher Education* – *Women challenges in the labour market*
Education policies and outcomes (Cluster 6)	– *The effect of Cash Transfer Programmes on education outcomes* – *Policy reforms, short- term, long-term, intended and unintended outcomes* – *Impact of the provision of Adult Education*

	– *Impact of private scholarship awards on financial aid displacement*
	– *Provision of support services through means-tested scholarships*
Education innovation and teacher practices (Cluster 7)	– *Innovation in the context of climate change (e.g. pedagogical interventions, climate literacy)*
	– *Co-created curriculums and co-teaching innovations*
	– *Teachers training programmes to promote environments for innovation in STEM fields*
	– *Creativity as a driver for innovation*
Digital education and technological impact (Cluster 8)	– *The impact of classroom-level digital programmes on learning outcomes*
	– *Digital Game Based learning interventions for instruction*
	– *Inequalities in students' access to technology (e.g. home computer ownership)*
	– *The emerging role of Artificial Intelligence (AI) in education.*
	– *Shortages of digital skills in the EU*

1.1. Exploring influence factors on student achievement

Numerous studies conducted during the period January-June 2024 explore the impact of factors on student academic achievement. Most of them concentrate on School Education, both at primary and secondary level. They primarily use academic achievement—typically measured by test scores—as their main analytical variable. However, other educational outcome variables also come into play in these analyses.

In primary education, Ruiz et al. (2024) reviews existent literature to explore which numeracy skills in the first year of school most reliably predict achievement in mathematics throughout primary school, aiming to recognise **which are the early indicators of later mathematical achievement**. The review includes fifty-four studies and acknowledges that several factors can affect the predictive power of early numeracy skills, including how these skills are operationalised, the measurement of mathematical ability, and sociodemographic characteristics. Drange and Sandsør (2024) study the effects of a free universal after-school programme on child academic performance in Norway primary schools and confirm its **positive effect on enrolment rates but not on academic performance or student wellbeing.** Their findings also indicate that the programme led to increased earnings for mothers with an immigrant background.

In secondary level, most studies highlight the effect of background factors on learning and future outcomes. Jackson et al. (2024) found that while all students benefit from attending school, the least advantaged students show the greatest improvements over time in graduation rates, socioemotional development, and behavioural outcomes. However, no significant impact was observed on test scores. Authors suggest that although test scores often reflect the reproduction of inequality among students, **the greater benefits of schooling for less advantaged students are more closely linked to other dimensions of school quality such as socioemotional and behavioural aspects.** In line with this results, Eren and Ozturk (2024) examine the effect of failing secondary school on adult criminal behaviour, economic self-sufficiency and several other medium-and long-run outcomes. The study found **varying effects based on students' ethnicity and race**. Additionally, students who fail school are more likely to require social assistance in adulthood. Lastly, Markussen and Røed (2023) found an **increasing intergenerational correlation between parents' earnings and academic achievement of offspring** attending schools in the last decades in Norway. In addition, **economically disadvantaged families have fallen behind** despite of the implementation of public policies that aim to tackle these inequalities. Nevertheless, the expansion of universal childcare and policies to reduce teacher-student ratio remain positive, especially for lower socio-economic level students.

In the US, Tobin (2024) explore the effect of school choice models that promote school competition between public schools and brings evidence on **how school choice**

negatively affects student achievement in public secondary schools. Moreover, the study found that school choice increased household influence and has **decreased teacher empowerment within schools.** In line with this results, Morton, Thompson, and Kuhfeld (2024) underline that an increase in teacher shortages due to burnout and turnovers since the COVID-19 pandemic has resulted in the expansion of the four-day school week in some states in the US. The authors explore the effects of this phenomenon on student achievement and growth, and estimate significant negative academic effects on reading achievement, but less in mathematics. In addition, the **negative effects of the four-day school week are estimated higher for female students and students in non-rural areas**.

In light of this global context, UNESCO (2024) published a report called '*The price of inaction: The global private, fiscal and social costs of children and youth not learning*' to highlight the consequences of the learning crisis, which is marked by widening academic gaps among school children and youth. This study **estimates fiscal and social costs of early school leaving and failing to attain basic cognitive skills, or adequate levels of socio-emotional skills for 159 countries**. Based on the analysis of multiple International Organisations sources, mainly from assessment and administrative data, the report provides conclusions and recommendations for policy action focused on quality and equity issues.

The use of assessment data to study the influential factors on education outcomes is very common. For instance, Ofek-Shanny (2024) examine the factors contributing to performance gaps between ethnic minority and majority groups. Given that socio-economic level often accounts for most of the explanatory capacity in academic differences in PISA results, **the authors explore whether engagement, rather than proficiency gaps, can help explain disparities in low-stakes evaluations.** They found that test engagement can account for more than 50% of the performance gaps and call for policymakers to make deliberate decisions regarding the stakes assigned to assessment tests. Teig and Steinmann (2023) explore which are the potential factors that makes school practices effective and equitable in Nordic countries. By using national and international large-scale assessment, they found **that the large differences in trends and results between these countries risks comparability**, regardless of their similarity in historical, cultural and economic characteristics. Nonetheless, the insights gained from each specific context remain relevant in the context of increasing educational inequalities.

In Higher Education, Granato et al. (2024) examine the **impact of Erasmus student mobility programme on student performance** in terms of graduation, academic scores and labour market outcomes. Applying a regression discontinuity design, authors found that Erasmus mobility not only **improves graduation of students enrolled in scientific and technical fields**, but that the impact is stronger for students who visit foreign universities of relatively lower quality compared to their home university. However, no statistical effect was found on labour market outcomes one year after graduation.

1.2 The intersection between education and the labour market

This section explores the relationship between Higher Education and the labour market, highlighting recent studies on skills development, university admission practices, career outcomes, and challenges in European job markets.

In relation to Higher Education admission practices, Silva (2024) asks **whether universities should select their students based on specialised, subject-specific criteria or a broader set of skills and knowledge** in Portuguese universities. The findings suggest that universities with less specialised admission policies admit a pool of students who achieve higher final Grade Point Averages (GPAs). Silva discusses these results in the context of a changing labour market. Hansen, Hvidman, and Sievertsen

(2024) investigate **how changes in university GPAs affect labour market outcomes** in Denmark. By examining a nationwide reform, they identified that the effect of GPA changes largely linked to changes in the grading scale and not to actual changes in student ability. However, the positive effect of a higher GPA on earnings decreases over time as employers gather more information about an employee's true productivity.

Teichert et al. (2024) examine the role of work experience and migration in the transition from university to the workforce in Germany. The regression analysis stresses the **relevance of mobility and work experience in reducing the length of the transition period**. Complementing these findings, the JRC (Seiger et al., 2024) has published two policy briefs raising attention to the persistent skills shortages across the EU, and in view of its consequences, the **increasing need to attract non-EU nationals in occupations with labour shortages and contribute to the twin transition in the EU**.

Regarding career outcomes, Pastorino (2024) argues about the relation between job and wage mobility finding that workers' beliefs about their abilities have a direct effect on their wages. Arellano-Bover (2024) examines the long-term effects of landing a first job at a large firm versus a small one in Spain. The findings confirm that **starting at larger firms persistently enhances long-term outcomes** due to higher quality skills development opportunities.

In the context of the partial retirement reform[5] in Germany which encourages early retirement among male workers, Ruhose, Thomsen, and Weilage (2024) discuss whether the **provision of Adult Education acts to keep older workers productive by engaging them voluntarily in learning**. Results show an increasing willingness of older workers to acquire skills and abilities independent of financial incentives.

At last, on global labour market trends, the OECD published the 'OECD Employment Outlook' in 2024. This report examines recent labour market trends, including changes in employment rates, wages, and new job vacancies worldwide (OECD, 2024). It also highlights the **rapid shifts in employment patterns, such as job losses in high-emission industries and the growth of sectors focused on low-emission activities**. In light of these findings, it offers recommendations for policymakers to address these transitions.

1.3 Gender gaps and educational choices

The NLP model identified a set of articles focusing on the persistent gender gaps in education and in the labour market. Most of these articles explore how gender affect students' choices throughout education, and particularly when accessing STEM and economic and business careers.

In primary education, Di Tommaso et al. (2024) explore the **role of teaching practices on gender gaps in mathematics**. They evaluate the causal effect of an intervention to improve children's skills in Italy by promoting peer interaction, sharing of ideas, learning from mistakes, and problem-solving. Results indicate an improvement on girls' performance and notable reduction in math gender gap.

In secondary level, studies identify gender gaps and explore its consequences on student performance and outcomes, especially for economic studies (Avery et al., 2024; Mašek, Potužák, and Serenini, 2024). In Czech Republic, Mašek, Potužák, and Serenini (2024) investigate the knowledge of Economics in secondary level students using data from Czech Economics Olympiad. They identified a gender gap among students and confirm problematic aspects in the Czech education systemin terms of quality across types of schools and regions. Likewise, Avery et al. (2024) study the **impact of a gender-neutral**

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[5] In this study, the authors refer to *partial retirement* as the possibility of drawing a pension early while continuing to work part-time (Ruhose, Thomsen, and Weilage, 2024).

change intervention to the content and instruction of introductory economics. The authors found improvements in women's grades (in comparison to men) and significant reduction of underperformance.

In Higher Education, studies explore different factors influencing the gender gap in STEM classes and economy courses. Beneito, Soria-Espín, and Vicente-Chirivella (2024) found that in Spanish universities, **STEM careers still have women as a minority, and that age is a significant variable affecting female students**, as older women are more likely to express a preference for high-earning, academically selective, and STEM degrees, while this effect is not significant for men. Asián Chaves et al. (2024) also explore the gender gap in Spanish universities focusing on access to economics and business administration degrees. The findings indicate that **women are underrepresented but there are improvements in academic performance and retention rates** during the studied period. These promising results are shared in the need to continue promoting women to choose economic studies.

In the US, Ahn et al. (2024) found that stricter grading standards for STEM courses tend to reduce enrolment, particularly among women. In view of this results, they recommend **revising grading policies to standardise average grades across classes to help bridge the gender gap.** Owen (2023) explores whether providing information about relative academic performance influences student choices and helps explain gender gaps in STEM fields. The findings confirm that offering such information has positive effects. However, they raise concerns about the **challenges in changing deep-rooted gender stereotypes and highlight the need for more intensive, targeted interventions to address these gaps effectively**.

Within the labour market, Janys (2024) explores the underrepresentation of women professors in academia and in economic fields. By proposing a test to detect hiring bias through implicit quotas (unspoken orientation to hire less individuals from a group) she describes that **German universities have an implicit quota of one or two women on the department level.** Similarly, Gallen (2024) examines the challenges faced by women in Danish workplaces and estimates an 8% 'gender productivity gap,' which contributes to gender wage inequalities**. This productivity gap is largely attributed to the impact of motherhood on women's careers**. However, while productivity differences explain the pay gap for mothers, they do not account for the pay gap for non-mothers.

1.4 Education policies and outcomes

Another set of articles provide valuable insights on the outcomes of implementing targeted education policies across various educational levels. These studies examine the effects of specific interventions and reforms, offering a comprehensive understanding of how different policies impact student achievement, retention, and overall educational quality.

Cash transfer programmes, both conditional and unconditional, are significant household policy interventions that have shown positive impact on children's school attendance and poverty reduction in multiple countries, particularly in developing nations (World Bank, 2020). Hızıroğlu Aygün et al. (2024) ask **whether unconditional cash transfers can keep refugee children in school and out of work** in the context of Turkey, a country that hosts the world's largest refugee population. Results indicate **large positive effects on child labour reduction, and an increase school enrolment and retention in refugee children.** These results are crucial for supporting policy aimed at refugee support.

In Hungary, Adamecz (2023) examines a secondary-level reform that proposed raising the compulsory school leaving age from 16 to 18 years. While the reform positively affected the length of schooling, it failed to reduce the dropout rates, particularly among the most at-risk group of Roma ethnic minority students. Additionally, the reform did not show an effect on employment rates and wages. The study concludes that **policies aimed at**

retaining students in secondary education should focus on achieving certification rather than merely extending the compulsory schooling age. In Germany, Schwerter, Netz, and Hübner (2024) analysed the long-term and unintended effects of an **instructional time school reform that proposes to reduce the number of school years and increase weekly instructional time for secondary school students**. They found a negative effect and increased time gap between school completion and access to Higher Education attributable to reform exposure. The authors highlight the **importance of studying unintended and long-term effects of school reforms on individual life courses.**

In the transition from secondary education to post-secondary studies, Lindström and Eklund Heinonen (2024) discuss the mid-term effect of adult education provision on post-secondary attainment. They found large positive effect of adult education on workers who were displaced during recession periods. In other words, **workers who attended secondary adult education invested in the continuation of studies, attending university or tertiary education**.

In post-secondary institutions, Lowry et al. (2024) explore the **impact of private scholarship awards on financial aid displacement** within the US system. They analyse how various components of students' financial aid packages—such as the cost of attendance, grants, and other scholarships—are adjusted when a private scholarship is awarded. Students often perceive this as unfair, as the anticipated reduction in their costs may not materialise when colleges offset the private scholarship by reducing other forms of aid. The authors argue that **these practices usually shift the benefit from students to institutions**, making the programmes more of a subsidy for colleges.

In Higher Education, different studies focus on **challenges in the provision of support services, scholarships and other education policies to contribute to students education** (Barnes, Fischer, and Kilpatrick, 2024; Grobon and Wolff, 2024). Based on public transfer data, Grobon and Wolff (2024) found that means-tested scholarships for students in French Higher Education institutions has led to a decrease in parental transfers to students. These results suggest that parents are effectively adjusting their private transfer decisions according to scholarship benefits, leading to believe that the scholarship is probably benefitting low-income parents who reduce the amount of money they give to their children. Authors highlight the importance of **analysing means-tested scholarships to guarantee appropriate allocation of public resources**.

1.5 Education innovation and teacher practices

The literature in this section explores innovative practices in education. In most cases, authors highlight the crucial role of teachers in implementing innovative classroom practices, such as curricular and pedagogical innovations, and in promoting student awareness and sensitivity to climate change consequences. Other literature focus on teacher's role in fostering creativity, collaboration, and sustainable practices.

In the context of the climate change crisis, the OECD published the report 'Rethinking education in the context of climate change' calling for education to rethink and innovate education practices (Nusche, Fuster Rabella, and Lauterbach, 2024). The study looks at **strategies to empower learners for action through curricular and pedagogical innovations** (e.g. cross-curricular learning, restructure science education) and proposes to increase school education system resilience through policy tools. Srivastava (2024) studies at the school level the efforts to ensuring climate literacy, and how this impact on the environment behaviour of children. Díez-Gutiérrez and Palomo-Cermeño (2024) examine the role of social education professionals in a changing society where **students must interact better with their social environment**. This interaction is increasingly crucial for developing students' environmental competencies in a globalized context.

In The Netherlands, Geurts et al. (2024) studied an innovative practice of curriculum co-creation between teachers and students in schools as a form to increase engagement on citizenship education. **Co-created curriculum proposes including students in the planning, acting and reflecting on the curriculum design**. Through the Participatory Action Research (PAR)[6] methodology, the author describes how teachers and students interact in the design, developing and the delivery of lessons. Similarly, Vembye, Weiss, and Hamilton Bhat (2024) studied co-teaching and related collaborative models of instruction which are widely used schools. They explored the effect of these collaborative models on students' academic achievement and search for the moderating factors. The authors found a moderate, yet significant effect of collaborative instruction compared to single-taught controls.

Pozo-Rico et al. (2024) studied the effectiveness of a training programme targeted at teachers in schools. The programme aims to empower them to manage change and enhance their competencies to **promote positive environments for innovation in STEM fields**, and ultimately enhance students' academic achievement and STEM competencies. The programme emphasized on project-based learning, real-life problem-solving, and interdisciplinary concepts. Results evidence that teachers improved job satisfaction, teaching efficacy and leaning towards innovation as well as students' academic performance in STEM disciplines.

According to Brauer, Ormiston, and Beausaert (2024), creativity drives learning and innovation. These authors study reviewed empirical studies to identify creativity-fostering teacher behaviours across all academic disciplines in Higher Education. With the results, they created a model that highlights the transdisciplinary, interactive, and interdependent nature of creativity-fostering teacher behaviours.

1.6 Digital education and technological impact

The final trend recognised in the literature on the economics of education concerns the advances in digital education and the technological impact on educational contexts. In the face of an accelerated digital technology integration in education (especially after the COVID-19) authors discuss the implications and applications at both the policy level and classroom level, as well as its influence on youth and the emerging role of artificial intelligence.

At the classroom level, Hall and Lundin (2024) examine the impact of one-to-one computer programmes on learning outcomes in primary schools in Sweden. Their study tests students' performance in language and mathematics, finding no significant effects on test scores. This suggests that **merely providing one-to-one computer access may not be sufficient to enhance academic performance**. Barz et al. (2023) explore the efficacy of Digital Game-Based Learning (DGBL) interventions compared to traditional instruction methods. Their research assesses DGBL interventions' effects on cognitive, metacognitive, and affective-motivational learning outcomes. The findings partially support the positive impact of DGBL interventions, indicating practical implications for their implementation in educational settings.

Djinovic and Giannakopoulos (2024) study the impact of home computer ownership on educational outcomes during adolescence in Greece. Their findings reveal that children aged 14–18 without computer access have a 10-percentage point higher probability of dropping out of school compared to those with access. This highlights the **significant disparities in human capital development due to unequal access to technology during critical developmental stages**. Elshani and Rrecaj (2023) examine the level of digital citizenship development in Kosovo. This mixed-methods study examines the role of public institutions in raising awareness, promoting, and managing digital citizenship. They

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[6] Participatory Action Research (PAR) assumes knowledge is rooted in social relations and most powerful when produced collaboratively through action (Geurts et al., 2024).

provide specific recommendations on how to address the challenges associated with digital citizenship development in the country.

In relation to AI, a World Bank publication (Molina et al., 2024), highlight the transformative impact of Artificial Intelligence (AI) on education. According to the article, **AI offers innovative opportunities to personalise learning experiences, support teachers and students in their daily tasks, and optimise educational management**. The study outlines the main developments driven by AI, emphasising its practical benefits for teachers, students, parents, and academic institutions. Galindo-Domínguez et al. (2024) study teachers' digital competence and their attitudes towards AI in education in Spain. Their study suggests that **while AI can provide positive effects for both teachers and students, there are still barriers hindering its adoption.** Despite teachers expressing a high willingness to use AI, they report low levels of personal experience with the technology, indicating a need for further training and exposure to fully harness AI's potential in educational settings.

Lastly, at the regional level, the rise in cyber-attacks has exposed significant vulnerabilities in current defence and operational systems, underscoring a **critical shortage of skilled cyber security professionals in Europe**. According to the (OECD, 2024) the demand for cyber security expertise has been analysed through online job postings in France, Germany, and Poland to understand the evolving landscape of cyber security policies and professional experiences worldwide, highlighting the urgent need to strengthen cyber security workforce capabilities.

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