10.22633/rpge.v29iesp4.20775

Revista on line de Política e Gestão Educacional
Online Journal of Policy and Educational Management

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CRITICAL THINKING IN EDUCATION: CROSS-CULTURAL PERSPECTIVES AND ANALYSIS OF AGGREGATED PISA INDICATORS

PENSAMENTO CRÍTICO NA EDUCAÇÃO: PERSPECTIVAS INTERCULTURAIS E ANÁLISE DE INDICADORES AGREGADOS DO PISA

PENSAMIENTO CRÍTICO EN LA EDUCACIÓN: PERSPECTIVAS INTERCULTURALES Y ANÁLISIS DE INDICADORES AGREGADOS DEL PISA

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How to reference this paper:

Kopac, L., Triebel, B., Berner, M. R., & Volkmann, U. (2025). Critical thinking in education: cross-cultural perspectives and analysis of aggregated PISA indicators. *Revista on line de Política e Gestão Educacional*, *29*(esp4), e025104. https://doi.org/10.22633/rpge.v29iesp4.20775

Submitted: 20/11/2025
Revisions required: 25/11/2025
Approved: 04/12/2025
Published: 20/12/2025

ABSTRACT: The paper analyses the development of critical thinking in the Slovak education system using cross-cultural evidence from PISA and PIAAC. As these assessments do not directly measure critical thinking, the study adopts proxy indicators such as reading literacy, problem-solving and creative thinking. Based on comparative secondary analysis of OECD datasets, the findings show a sustained decline in Slovak reading literacy, a high share of low performers, below-average creative thinking results and weaker adult problem-solving skills. The evidence points to persistent gaps in higher-order cognitive skills. Cross-country patterns indicate alignment with global dynamics driven by digitalisation, socioeconomic inequality and shifting learning behaviours. The paper recommends systemic reforms centred on curriculum redesign, teacher development, early interventions and structured support for dialogic and inquiry-based pedagogies. Strengthening critical thinking is framed as a strategic priority for academic performance, labour-market competitiveness and societal resilience.

KEYWORDS: Critical thinking. Cross-cultural comparison. Education policy. PISA. Slovakia.

RESUMO: *O artigo analisa o desenvolvimento do pensamento crítico no sistema educacional eslovaco com base em evidências interculturais provenientes do PISA e do PIAAC. Como essas avaliações não medem diretamente o pensamento crítico, o estudo utiliza indicadores substitutos, como letramento em leitura, resolução de problemas e pensamento criativo. A partir de uma análise secundária comparativa de bases de dados da OCDE, os resultados indicam queda contínua no letramento em leitura na Eslováquia, alta proporção de estudantes com baixo desempenho, resultados abaixo da média em pensamento criativo e habilidades reduzidas de resolução de problemas entre adultos. As evidências apontam lacunas persistentes em habilidades cognitivas de ordem superior. Os padrões internacionais revelam alinhamento com dinâmicas globais associadas à digitalização, desigualdades socioeconômicas e novas práticas de aprendizagem. O artigo recomenda reformas sistêmicas focadas em redesenho curricular, desenvolvimento docente, intervenções precoces e apoio estruturado a práticas dialógicas e investigativas. Fortalecer o pensamento crítico é apresentado como prioridade estratégica para o desempenho acadêmico, a competitividade no mercado de trabalho e a resiliência social.*

PALAVRAS-CHAVE: *Pensamento crítico. Comparação intercultural. Política educacional. PISA. Eslováquia.*

RESUMEN: *El artículo analiza el desarrollo del pensamiento crítico en el sistema educativo eslovaco a partir de evidencia intercultural de PISA y PIAAC. Dado que estas evaluaciones no miden directamente el pensamiento crítico, el estudio emplea indicadores sustitutos, como alfabetización lectora, resolución de problemas y pensamiento creativo. Con base en un análisis secundario comparativo de bases de datos de la OCDE, los hallazgos muestran una disminución sostenida en la alfabetización lectora en Eslovaquia, una alta proporción de estudiantes con bajo rendimiento, resultados por debajo del promedio en pensamiento creativo y habilidades más débiles de resolución de problemas entre adultos. La evidencia señala brechas persistentes en habilidades cognitivas de orden superior. Los patrones internacionales indican alineación con dinámicas globales impulsadas por la digitalización, la desigualdad socioeconómica y los cambios en los hábitos de aprendizaje. El artículo recomienda reformas sistémicas centradas en el rediseño curricular, el desarrollo docente, intervenciones tempranas y apoyo estructurado a pedagogías dialógicas y basadas en la indagación. El fortalecimiento del pensamiento crítico se presenta como una prioridad estratégica para el desempeño académico, la competitividad laboral y la resiliencia social.*

PALABRAS CLAVE: *Pensamiento crítico. Comparación intercultural. Política educativa. PISA. Eslovaquia.*

Article submitted to the similarity system

iThenticate

Editor: Prof. Dr. Sebastião de Souza Lemes
Deputy Executive Editor: Prof. Dr. José Anderson Santos Cruz.

doi 10.22633/rpge.v29iesp4.20775

INTRODUCTION

Critical thinking is currently regarded as one of the most essential key competencies of the 21st century. Its significance is emphasized not only by researchers and educational institutions but also by international organizations such as the Organisation for Economic Co-operation and Development (OECD) and United Nations Educational, Scientific and Cultural Organization (UNESCO), which highlight critical thinking as a universal skill essential for functioning in diverse cultural and societal contexts. Critical thinking is commonly understood as the ability to analyze information, evaluate arguments, identify logical fallacies, and make decisions based on evidence (Facione, 2015; Paul & Elder, 2019).

In a globalized and digitally interconnected world, the need for critical thinking is becoming increasingly urgent. Pupils and students across different cultures are exposed to vast quantities of information whose quality and reliability vary widely (Darling-Hammond, 2008; Jukes & McCain, 2002). Without the ability to critically appraise such information, not only their academic success but also civic participation, intercultural understanding, and resilience to disinformation are at risk (Halpern, 2014). As a result, critical thinking extends beyond traditional schooling and represents a fundamental prerequisite for lifelong learning, global citizenship, and navigating culturally diverse environments.

Although a contemporary term, critical thinking has deep philosophical roots across civilizations. While the Socratic tradition in ancient Greece urged learners to question accepted opinions and seek truth through dialogue, similar traditions can be found in other cultures—for example, the Confucian emphasis on reflective judgment or the Islamic scholarly tradition of ijtihad, which encouraged independent reasoning. These cross-cultural intellectual traditions represent some of the earliest systematic attempts to cultivate critical inquiry (Paul & Elder, 2014).

In the 20th century, Dewey contributed to the modern concept by viewing thinking as a process of problem-solving and emphasizing the role of reflection (Dewey, 1998). Bloom's taxonomy further conceptualized higher cognitive levels—analysis, synthesis, and evaluation—as foundational elements of critical thinking (Bloom, 1956).

Critical thinking is a metacognitive process that, through purposeful and reflective judgment, increases the likelihood of arriving at a logical conclusion or practical solution. Teaching critical thinking is therefore essential because it enables individuals to gain a more comprehensive understanding of the information they encounter, supporting sound decision-making and problem-solving in real-world applications, including intercultural communication and collaboration (Butler et al., 2012; Halpern, 2003; Ku, 2009). The Organisation for Economic Cooperation and Development (OECD) repeatedly emphasizes the importance of critical and

creative thinking as essential skills for life and work in a changing and culturally diverse world (OECD, 2024).

Slovakia faces several challenges in this area. International PISA assessments have consistently shown that Slovak students perform below the OECD average, with a growing proportion of students who fail to reach even the minimum level of reading and mathematical literacy (OECD, 2023). This signals that the education system does not sufficiently develop the foundational competencies that are prerequisites for critical thinking.

This article aims to analyze critical thinking in the Slovak education system using data from international assessments, such as PISA and PIAAC, as well as other OECD indicators. Emphasis is placed on the fact that PISA has never directly measured critical thinking; instead, it uses proxy indicators that are closely linked to it.

LITERATURE REVIEW

Definitions of critical thinking

Although developing critical thinking skills is considered essential for successful adaptation to the modern world (Halpern, 2003), there is still no consensus about its definition (Bensley, 1998; Ennis, 1987; Moseley et al., 2005; Paul, 1993) or its relationship to other cognitive processes such as memory and comprehension (Dwyer et al., 2012; Halpern, 2003). This lack of consensus is further complicated in cross-cultural contexts, where educational traditions, communication norms, and epistemological assumptions differ, raising the question of whether critical thinking should be understood as a universal construct or as one that is expressed differently across cultures.

Ennis (1987) defines critical thinking as "reasonable and reflective thinking focused on deciding what to believe or what to do." This approach highlights the practical application of critical thinking in everyday decision-making. It highlights the dispositional aspect (a willingness to think critically), which cultural norms regarding authority, dialogue, and disagreement may influence.

Facione (1990, 2015), in the Delphi study, states that critical thinking is a "purposeful, self-regulatory judgment which results in interpretation, analysis, evaluation, and inference, as well as explanations of the evidential, conceptual, methodological, criteriological, or contextual considerations upon which that judgment is based." Facione emphasizes the structure of cognitive processes and sets out a comprehensive framework of intellectual skills and dispositions that can, in principle, be applied in diverse cultural and disciplinary settings.

Halpern (2014) understands critical thinking as "the use of cognitive skills or strategies that increase the probability of a desirable outcome." The key here is the transferability of these skills across context, academic, professional, and every day, which also implies the need to adapt critical thinking instruction to culturally specific situations and problem types.

Paul and Elder (2014) define critical thinking as "the art of analyzing and evaluating thinking with a view to improving it." Their approach is strongly normative, offering criteria for the quality of thinking: clarity, accuracy, relevance, logic, and fairness. Many of these criteria align with international educational frameworks; however, their interpretation may vary in cultures that prioritize harmony or consensus over direct critique.

Kuhn (1999) refers to critical thinking as metacognition, meaning to possess knowledge about one's own and others' knowing. She claims that meta-knowing skills are the "skills most closely associated with critical thinking," which is particularly relevant in multicultural settings where individuals must reflect not only on their own assumptions but also on culturally shaped perspectives of others.

These definitions share common elements; they emphasize analysis, evaluation, logical reasoning, self-reflection, and decision-orientation. They agree that critical thinking is not only a cognitive ability but also an attitude and willingness to question assumptions (Garbarová & Vartiak, 2021). They differ in emphasis: Ennis stresses practical use, Facione cognitive processes, Halpern transferability, Paul and Elder (2014) normative criteria, and Kuhn (1999) meta-knowing. From a cross-cultural perspective, they collectively suggest that while the core components of critical thinking may be widely applicable, their development and expression are influenced by cultural values, educational practices, and social expectations.

Models of Critical Thinking

Numerous authors and international documents highlight the importance of critical thinking in education. The European Commission (2016) lists it among key competencies for lifelong learning. The OECD, within the Future of Education and Skills 2030 initiative, underscores the need to develop higher-order competencies, including critical thinking. The United Nations Educational, Scientific and Cultural Organization (UNESCO, 2017) emphasizes that developing critical thinking is essential for building peace, sustainability, and democratic participation.

Based on these definitions, several models have emerged that systematize critical thinking and offer practical frameworks:

- The Paul–Elder model identifies elements of thought (purpose, questions, information, and interpretation) and criteria for evaluation (clarity, accuracy, relevance,

and logic). It emphasizes the metacognitive dimension and aims to teach individuals to evaluate the quality of their own thinking (Paul & Elder, 2014);

- Ennis's model—systematizes critical thinking into specific abilities: identifying arguments, evaluating evidence, recognizing assumptions, and formulating conclusions. It is considered a practically oriented framework suitable for pedagogy (Ennis, 1987);
- Facione's model defines six basic intellectual skills: interpretation, analysis, evaluation, inference, explanation, and self-regulation. It also emphasizes dispositions such as open-mindedness, systematicity, and perseverance. This model is most frequently used in research because it was developed through expert consensus (Facione, 2015);
- Perry's scheme emphasizes the development of students' thinking from "right/wrong" (i.e., assuming only one correct answer) to a contextual way of thinking that allows for relativity and different approaches to answer a question or solve a complex problem (Taber, 2025). Perry does not explicitly use the term "critical thinking," but his developmental approach was considered in Kuhn's elaborations three decades later;
- Kuhn's model describes the development of critical thinking, like Perry's. At the starting position, assertions made by others are assumed to be correct; however, during the development process, personal opinions and uncertainties lead to rethinking and questioning whether the statements are true or false. The model builds upon the term metacognition, which refers to self-reflection and possessing knowledge about one's own current level of knowledge. Critical thinking develops through the increasing metacognitive reasoning (Kuhn, 1999).

These models are often combined when designing educational programs aimed at developing critical thinking. For example, the Paul–Elder framework can be applied in day-to-day didactics, while Facione provides an analytical basis for research and measurement.

Factors influencing critical thinking

Multiple individual, social, and pedagogical factors condition the development of critical thinking.

- Pedagogical approaches: Research shows that discussions, projects, problem-solving, and reflective tasks support the development of critical thinking, whereas passive memorization constrains it (Abrami et al., 2015);

- Socioeconomic status (SES): Higher SES entails better access to educational resources and often leads to higher levels of critical thinking (OECD, 2022). In Slovakia, pronounced differences have been identified between urban and rural schools;
- Digital competencies: Using digital tools strengthens analytical thinking and the ability to verify information. In the age of artificial intelligence, these competencies are increasingly important (Redecker et al., 2011);
- Cultural and gender factors: PISA results indicate that girls perform better in reading, whereas boys do slightly better in mathematics. Regional differences are primarily linked to socioeconomic context (OECD, 2024).

Pedagogical research confirms that critical thinking can be deliberately developed through appropriate teaching strategies, including problem—based learning, discussion, argumentation, reflective writing, and project-based learning (Abrami et al., 2015). Implementing these strategies, however, requires systematic support and methodological guidance for teachers (Halpern, 2014; Garbarová & Vartiak, 2024).

Assessing critical thinking

Measuring critical thinking is a methodological challenge, as it is a complex construct. In practice, various tools are used:

- Watson–Glaser Critical Thinking Appraisal: focused on analytical and evaluative skills, used primarily in psychology and HR;
- PISA tests: while they do not directly measure critical thinking, their domains of reading, problem-solving, and creative thinking can be considered relevant proxy indicators (OECD, 2022, 2024);
- PIAAC: an international survey of adult skills that includes problem-solving in technology-rich environments (OECD, 2023);
- Researchers agree that a combined, multi-method approach is the optimal way to assess critical thinking (Halpern, 2014; Facione, 2015).

Synthesis

The definitions, models, and factors above show that critical thinking is a multidimensional construct encompassing cognitive skills, dispositional aspects, and normative criteria of thought quality. While authors approach it differently, they converge on analysis, evaluation, logic, and self-reflection. Models such as Paul–Elder, Ennis, and Facione provide frameworks

applicable in research and pedagogy. At the same time, empirical studies confirm the importance of individual, social, and didactic factors in the development of this concept. Assessing critical thinking remains a methodological challenge; a combined, multitool approach is considered most effective. This theoretical framework thus forms the basis for the empirical analysis that follows, contributing to a deeper understanding of how critical thinking develops in educational settings.

METHODOLOGY

Research Design

This paper employs a comparative secondary analysis of aggregated data, focusing on long-term trends in Slovakia's performance in international assessments, PISA and PIAAC. We compare results with the OECD standard and selected Central European countries (Czechia, Poland, Hungary) to assess Slovakia's relative position.

Methodologically, it is a comparative secondary analysis of aggregated data. The methodological framework relies on secondary, aggregated data from OECD international surveys: PISA (Program for International Student Assessment, cycles 2009–2024) and PIAAC (Program for the International Assessment of Adult Competencies, 2023). Both assessments are based on representative samples, utilizing a standardized test design and psychometric modelling (Item Response Theory—IRT) with weighting to ensure the reliability and representativeness of the results (OECD, 2023).

Proxy operationalization

Since PISA and PIAAC do not directly test (measure) critical thinking, we operationalized it using proxy indicators that, according to the literature and OECD methodological guidance (Facione, 2015; Halpern, 2014; Paul & Elder, 2019), correspond most closely to higher-order abilities characteristic of critical thinking:

- Reading literacy (PISA 2009–2022): understood as the ability to comprehend text, analyze arguments, and evaluate their validity (Ennis, 2018);
- Problem-solving (PISA 2012, 2015): the use of logical reasoning and adaptive strategies in novel situations (Halpern, 2014);
- Creative thinking (PISA 2024): the creation and evaluation of original and relevant solutions as a complement to normative critical thinking (OECD, 2024);

- Adult skills in problem-solving in technology-rich environments (PIAAC 2023)—the ability to analyze complex situations and use digital tools essential for critical thinking (OECD, 2023).

The empirical part of this article is based on aggregated data from PISA 2022 and PISA 2024, as the OECD will release student-level microdata with a delay. Aggregated indicators nevertheless provide a robust basis for trend analysis and for comparing Slovakia with the OECD average. For a broader context, we also include results from PIAAC 2023, which examines the level of basic and higher cognitive skills among the adult population (OECD, 2023), and from education at a Glance 2025, which provides comparable statistics on education systems in OECD countries.

Data sources and variables

The analysis utilizes secondary, aggregated, and officially published data from international surveys, including PISA (2009–2024) and PIAAC (2023), as well as country notes and OECD technical standards (OECD, 2022, 2023, 2024). The main variables used are:

- Mean reading literacy score (PISA; country averages for cycles 2009, 2012, 2015, 2018, 2022).
- Share of students below Level 2 in reading/mathematics/science (PISA 2022).
- Mean score in the domain of creative thinking (PISA 2024).
- Mean adult score in problem-solving in technology-rich environments (PIAAC 2023).
- Demographic and contextual aggregated indicators (OECD average; neighboring countries: Czechia, Poland, Hungary) are used for comparison.

Sample selection

All data come from OECD international assessments (PISA 2009–2024, PIAAC 2023), which use two-stage stratified sampling. In the first stage, schools are selected to represent regions, school sizes, and types of providers. In the second stage, 15-year-old students (PISA) or adults aged 16–65 (PIAAC) are randomly selected from within schools.

Sampling is designed to ensure representativeness for the target population in each country, using specific weights to compensate for different selection probabilities and to account for non-response. Results are therefore comparable across countries and cycles, meeting international standards for representativeness and statistical reliability (OECD, 2023).

Analytical framework

Methodologically, this is a comparative secondary analysis of aggregated data. We consider long-term trends in Slovakia's PISA performance, using the OECD average and selected Central European countries as comparators. Critical thinking is operationalized through the proxy indicators noted above. The analysis is predominantly descriptive but anchored in the theoretical framework of definitions and models of critical thinking.

Methodological limitations

Using proxy indicators brings methodological limitations. Critical thinking is a multidimensional competence that includes not only cognitive skills but also dispositional factors such as intellectual humility, openness to evidence, and a willingness to question one's own assumptions (Facione, 2015; Paul & Elder, 2019). PISA and PIAAC do not capture these dimensions. PISA captures only a portion of this complexity; we therefore interpret the results as indicators of trends and Slovakia's relative position, rather than as a detailed picture of individual student differences.

A further limitation is the use of only aggregated, country-level data, which does not allow for more detailed statistical modelling (e.g., individual-level regression), modelling of individual factors (e.g., socioeconomic status, school type), or causal interpretations. Results are therefore understood as trend indicators and relative positioning in an international context. Nevertheless, we regard the results as methodologically robust because they offer high explanatory value for analyzing trends, international comparisons (OECD, 2023), and education policy-making.

RESULTS

Trends in reading literacy performance

PISA results show that Slovak students' reading literacy has trended downward since 2009. In 2009, students achieved an average of 477 points; in 2012, there was a slight improvement to 482, but then a decline followed: 463 in 2015, 458 in 2018, and only 447 in 2022 (OECD, 2023). In the latest cycle, Slovakia was thus below the OECD average of 476. According to PISA 2009–2022, the mean Slovak reading score has been gradually decreasing (OECD, 2023).

There is a gradual decline in Slovakia's failure to stabilize or improve reading literacy. This is worrying because reading is a foundational competence necessary for the development

of critical thinking. Slovakia achieved its highest score in 2012 (482); since then, results have fallen. The drop to 447 in 2022 means Slovak students are almost 30 points below the OECD average—roughly one school year—and the difference is statistically significant, underscoring the seriousness of the situation (OECD, 2023).

The problem is even more serious regarding the share of students who do not reach the minimum level of competence (Level 2). According to PISA 2022, the Slovak shares below this threshold were:

- Reading: 32.2% of students, considerably more than the OECD average (26%);
- Mathematics: 31.9% vs 29% (OECD);
- Science: 28.3% vs 24.5% (OECD) (OECD, 2023).

Thus, in PISA 2022, as many as 32.2% of Slovak students scored below Level 2 in reading, above the OECD average (26%). A similar situation is held in mathematics and science (OECD, 2023).

There are differences between Slovakia and the OECD average. The data indicate that in each domain, Slovakia has a higher share of students at or below Level 2. In other words, roughly a third of Slovak 15-year-olds face severe difficulties with tasks considered essential prerequisites for success at school and in life. The fact that almost a third of students do not reach even the basic level poses a threat to their prospects. Compared to Czechia (24%) or Poland (22%), Slovakia fares worse, indicating systemic shortcomings (OECD, 2023). This alarming state suggests weaknesses in the Slovak education system and highlights the need for targeted interventions.

Gender differences in reading literacy

PISA 2022 also revealed gender differences. In reading, Slovak girls scored an average of 459 points, while boys scored only 435, resulting in a 24-point gap (OECD, 2023). This difference is comparable to the OECD average (29 points), but in Slovakia, it indicates a systematic disadvantage among boys, whose reading competencies are weaker. There are also gender differences. While girls approach the OECD average, boys lag significantly behind, with implications for the development of their critical thinking and their ability to participate successfully in the labor market. The gap signals a systematic disadvantage for boys that requires pedagogical attention and differentiated approaches.

Creative Thinking in PISA 2024

PISA 2024 brought the first results in the area of creative thinking. Slovakia scored an average of 27 points on a 1-60 scale, whereas the OECD average was 32 (OECD, 2024). Slovakia thus ranks among the countries with below-average performance. The most successful included Singapore (38), South Korea (37), and Canada (35).

The result suggests that the Slovak education system struggles not only with developing foundational competencies, but also with stimulating creativity and innovation—areas that the OECD directly links to critical thinking (OECD, 2024). Slovakia significantly lags behind countries such as Korea (37) or Singapore (38). This suggests a lack of connection between school education and the development of creative and critical thinking. The results also indicate a deficit in fostering creative and innovative competencies, which are key to 21st-century critical thinking.

Adult skills: PIAAC 2023

Analysis of data from the international PIAAC 2023 survey reveals that Slovakia's adult population also scores below the OECD average in problem-solving in technology-rich environments. Slovak adults scored an average of 271 points, compared with the OECD average of 283 (OECD, 2023).

Weak PIAAC results confirm that the critical-thinking problem concerns not only students but also adults. This has negative consequences for the labor market, competitiveness, and the country's innovation potential.

All these findings underscore the need for systemic reforms that emphasize the development of key competencies underlying success in schooling, work, and society.

Statistical Significance

Although the analysis uses aggregated data, all differences between Slovakia and the OECD average exceeding 10 points are, according to OECD methodology, statistically significant at $p < .05$ (OECD, 2023). For completeness, standard errors and 95% confidence intervals are available in OECD databases.

DISCUSSIONS

Our analysis confirmed a pronounced and persistent decline in Slovak students' mean reading scores from 2012 to 2022, alongside a higher share of students scoring below Level 2 compared to the OECD average. The PISA 2024 creative-thinking results are below average,

confirming challenges in developing higher-order skills that underpin critical thinking (Halpern, 2014; Facione, 2015).

Significance of the decline: A drop of roughly 30 points in reading—more than one school year—represents a significant educational deficit. This phenomenon is drawing attention not only in Slovakia but also in broader scientific and policy debates about the quality of education. Long-term declines in reading negatively affect students' ability to analyse texts and arguments, conclude, and solve problems—key components of critical thinking (Paul & Elder, 2014).

Inequalities and SES: The strong influence of SES and regional differences is also evident in our data. A higher share below Level 2 is associated with social disadvantage, which necessitates addressing not only school methods but also the broader social determinants of education (OECD, 2023; Abrami et al., 2015).

Gender gap: The consistent 20–25-point gender gap in reading between girls and boys is a global phenomenon. Its causes are complex, including social expectations, motivation, and specific educational approaches. This disparity necessitates differentiated didactic strategies aimed at supporting lower-performing students (OECD, 2023).

Creative thinking: Below-average ratings in creative thinking in PISA 2024 indicate insufficient stimulation of divergent thinking and creativity in teaching. This is likely due to the dominance of transmissive and memorization-heavy methods that educational reforms have not yet fully overcome (Abrami et al., 2015; Redecker et al., 2011).

Methodological explanations and alternative interpretations

It should be emphasized that PISA measures performance in specific, controlled situations, which can limit the transfer of results to real-world learning and behavior. Low scores may, in addition to lower skill levels, also reflect insufficient preparation for the test task types (construct validity) (OECD, 2024).

When interpreting aggregated data, one must avoid the ecological fallacy—drawing inferences about individuals from group-level data without microdata or experimental studies to confirm causality (Raudenbush & Bryk, 2002).

Policy recommendations

Based on our findings, we propose concrete steps:

- Curriculum redesign: explicitly embed standards and outcomes focused on critical thinking across subjects, with an emphasis on argumentation, evaluative writing, and appraisal of arguments (Abrami et al., 2015);
- Teacher development: systematic programs for teachers, including modelling of facilitation techniques, formulation of higher-order questions, and assessment of argumentation (Halpern, 2014);
- Dialogic teaching: include dialogues in pedagogy, in which students learn to uncover assumptions, evaluate arguments, listen and engage with each other (Nussbaum et al., 2023);
- Targeted interventions for vulnerable groups: support programs in rural and marginalized regions; early reading interventions in preschool and early school years yield high returns (Darling-Hammond, 2008);
- Enhanced diagnostics: implement regular national/regional measures of higher-order competencies; secure access to microdata for research and policy evaluation;
- Digital literacy and tools: Invest in tools that support verification of information and evaluation of sources (Redecker et al., 2011);
- Support for creativity in school: project-based learning, creative workshops, and cross-curricular projects to foster divergent thinking.

The results show that Slovakia has long lagged in reading literacy and in other areas related to critical thinking. The downward trend underscores the need for systemic changes. The share of students below Level 2 is alarming and higher than in neighbouring countries (Czechia: 24%, Poland: 22%, Hungary: 28%). This gap may be linked to the quality of the school system, inequalities between urban and rural schools, and the socioeconomic status of families (Cannistrà et al, 2022; Cannistrà et al, 2024).

The gender gap is noteworthy girls consistently outperform boys in reading, while boys tend to excel slightly in mathematics. This confirms the need for differentiated pedagogical approaches. In creative thinking, Slovakia lags significantly not only behind Asian countries but also behind the OECD average. This deficit points to weak connections between schooling and the development of innovative and reflective skills. Adults also score lower in PIAAC, which shows the need for lifelong learning.

The decline in reading literacy is not solely a Slovak phenomenon. The OECD (2023) notes similar trends in other Central and Eastern European countries, as well as in Finland, which has long been regarded as a reading leader. This broader context suggests that the problems relate not only to national policies but also to global changes in reading habits, digitalization, and shifting educational preferences among young people.

Paper limitations

Discussion of the results must also consider the broader context, including the digital transformation of education, new forms of work, and the need for resilience in the face of disinformation, which raises the bar for critical thinking. Slovakia faces a challenge in systematically developing these competencies so that pupils and adults can succeed in both the global labor market and a democratic society.

The limitations of the paper lie in our use of secondary aggregated data, which do not offer a complete picture of individual learning strategies or specific regional conditions. Future research should therefore complement this with qualitative studies and experimental interventions to verify the effectiveness of pedagogical approaches aimed at developing critical thinking:

- Aggregated data: we cannot model student heterogeneity or control for individual confounders (such as family background and parents' prior education);
- Proxy measurement: critical thinking is not directly measured; results are interpreted as indicators of predispositions to develop critical thinking;
- Potential sources of testing/measurement bias: translation of test items (if a test is translated, the meaning, nuances, or phrasing can shift); cultural differences in understanding tasks (some tasks may presuppose knowledge or experiences typical for one culture); differences in test implementation (in-person vs online, time-limited vs not, differing instructions). All of these may mean that scores reflect not only actual ability but also language, culture, or administration mode. These are potential sources of inaccuracy or bias;
- Ambiguous causality: given the cross-sectional nature of country data, it is difficult to draw causal conclusions; one can observe correlations or concurrent relationships, not causal links (OECD, 2024; Halpern, 2014);
- Suggestions for Further Research (practical and prioritized);
- Obtain and analyze PISA microdata as soon as released; conduct multilevel analyses controlling for SES, school type, and regional factors (Raudenbush & Bryk, 2002);
- Randomized controlled trials (RCTs), when introducing teacher CPD programs focused on critical thinking, track the transfer of acquired skills to student outcomes;
- Longitudinal (cohort) tracking: examine whether early intervention programs produce long-term improvements in PIAAC results and in labor-market outcomes;
- Cost-effectiveness analyses of recommended interventions: to identify which measures deliver the most significant benefit per euro of investment.

CONCLUSIONS

Critical thinking is an essential competence that Slovak schooling must deliberately cultivate. PISA and PIAAC results clearly show weaknesses in reading, problem-solving, and creative thinking. If Slovakia is to succeed in global competition, it must devote systematic and long-term attention to developing critical thinking.

This article maps the relationship between international assessments (PISA, PIAAC) and the prerequisites for developing critical thinking in the Slovak Republic. The main findings can be summarized as follows:

- Slovakia shows a long-term declining trend in reading literacy (2009–2022) and a higher share of students below Level 2 compared with the OECD average and some neighboring countries (OECD, 2023);
- Gender and regional/SES inequalities suggest systemic problems rather than one-off anomalies;
- Below-average scores in creative thinking (PISA 2024) and lower adult scores (PIAAC 2023) confirm that deficits in higher-order skills persist into adulthood and may constrain the country's economic and innovation potential (OECD, 2023, 2024).

Based on this evidence, we recommend three priority steps for education policy and practice:

1. Rapid implementation of teacher CPD programs focused on evaluating arguments, moderating discussions, and problem-based learning (Abrami et al., 2015);
2. 2Targeted interventions in vulnerable regions and support for early reading development to reduce SES disparities and lower the share below Level 2;
3. 3Ensure access to micro-level data and invest in local experiments (RCTs) and long--term evaluation to verify which policies deliver sustainable improvements.

CONCLUDING NOTES ON CREDIBILITY AND FUTURE RESEARCH

Despite the limitations of using aggregated proxy data, this article provides consistent and robust evidence of the need for systematic changes in the Slovak education system. To make fully evidence-based decisions, we recommend urgently (a) obtaining PISA/PIAAC microdata for deeper analysis, (b) piloting RCTs of teacher development programs, and (c)

regularly monitoring results using standardized indicators of critical thinking (combining tests and performance tasks).

The analysis confirms that Slovakia performs below average in competencies associated with critical thinking. Trends in reading literacy, the high share below the basic level, and weak results in creative thinking and PIAAC indicate the need for systemic changes in education.

The most important recommendations are: systematically develop critical thinking across subjects, strengthen teacher preparation, reduce regional and socioeconomic disparities, and deliberately foster digital and innovation competencies.

Slovakia must focus on connecting education with real life, on supporting discussion, argumentation, and project-based learning. Only then can we strengthen the capacity of students and adults to face the challenges of the 21st century. Future research should analyze in greater detail the effects of interventions aimed at critical thinking and track their impact on student outcomes and on society. We therefore recommend making regular domestic measurements of higher-order competencies and systematically monitoring their trends as part of national education policy. Without such steps, Slovak students and adults risk having limited capacity to succeed in the global labor market and to participate actively in a democratic society.

Slovakia also faces the risk of deepening regional and social disparities if targeted, sustainable measures to support critical thinking and reading literacy are not implemented. If the Slovak Republic fails to introduce systematic measures—targeted teacher preparation, improved reading literacy, and curriculum modernization—the gap with OECD and neighboring countries will widen, which may negatively affect not only the competitiveness of the economy but also the quality of civic participation and society's resilience to disinformation.

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CRediT Author Statement

Acknowledgements: No.
Funding: This research did not receive any financial support.
Conflicts of interest: There is no conflict of interest.
Ethical approval: The work respected ethics during the research.
Data and material availability: The data and materials used in the work are not publicly available for access.
Authors' contributions: 15 % each author.

Processing and editing: Editora Ibero-Americana de Educação
Proofreading, formatting, normalisation and translation