Co-funded by the European Union

ERASMUS+ PROGRAMME

KEY ACTION 2 STRATEGIC PARTNERSHIPS

2025-1-ES01-KA220-SCH-000358138

BrAIn: Title: BrAIn First, Technology Next - Students First, AI Second

The Final List of 5 Skills Impacted by AI in Primary Education

1) Introduction

This document presents the final selection of five key soft skills most impacted by Artificial Intelligence (AI) exposure in primary and lower secondary education. The selection is the result of WP2 cross-national analysis, integrating national desk research and classroom implementation data provided by seven partners across four countries.

The aim is to identify competences that are consistently influenced by AI, are observable in classroom practice, and are critical for responsible, reflective, and human-centred learning in AI-supported educational contexts.

2) Methodology

A comparative analysis was conducted using data from all partner countries.

The following sources were used:

- National Desk Researches conducted by non school partners
- Classroom implementation results carried out by school partners and Teacher Feedback Reports collected during the implementation phase
- National Identification of 5 Skills documents developed separately by school and non-school partners

The selection was based on:

- Frequency across countries
- Strength and consistency of evidence from multiple data sources
- Alignment with WP2 objectives
- Relevance to AI exposure in primary education

3) Cross-Country Analysis

The cross-country analysis integrates findings from both national desk research and classroom implementation processes conducted by partner countries.
This approach ensures a comprehensive understanding of how Artificial Intelligence (AI) influences competence development in primary education by combining theoretical evidence with practical classroom observations.

✓ = Clearly identified and evidenced
(✓) = Indirect / supporting evidence

#	Skill	Spain	Denmark	Bulgaria	Türkiye	Total	Evidence
1	Critical Thinking	✓	✓	✓	✓	4/4	Desk research and classroom implementation

2	Creativity	✓	(✓)	(✓)	✓	4/4	Classroom implementation
3	Problem-solving	✓	(✓)	(✓)	✓	4/4	Desk research and classroom implementation
4	Communication	✓	✓	✓	(✓)	4/4	Classroom implementation
5	Collaboration	(✓)	✓	✓	✓	4/4	Classroom implementation
6	Digital competence	✓	✓	✓	✓	4/4	Desk research and classroom implementation
7	AI literacy	✓)	✓	(✓)	✓	4/4	Desk research (supported by classroom data)
8	Ethical judgment	✓	✓	✓	✓	4/4	Desk research and classroom implementation
9	Adaptability	(✓)	(✓)	–	(✓)	3/4	Desk research
10	Self-management	–	(✓)	–	–	1/4	Desk research
11	Emotional intelligence	–	(✓)	–	–	1/4	Desk research
12	Resilience	–	(✓)	–	–	1/4	Desk research
13	Analytical thinking	(✓)	✓	–	(✓)	3/4	Desk research
14	Information literacy	✓	✓	✓	✓	4/4	Desk research and classroom implementation
15	Decision-making	(✓)	✓	–	(✓)	3/4	Desk research
16	Learning readiness	–	✓	–	–	1/4	Desk research
17	Innovation competence	(✓)	(✓)	–	✓	3/4	Classroom implementation
18	Empathy	(✓)	(✓)	–	–	2/4	Desk research
19	Systems thinking	–	✓	–	–	1/4	Desk research
20	Intercultural understanding	–	(✓)	–	–	1/4	Desk research

Across all partner countries, similar patterns were observed:

- Students often initially rely on AI outputs without questioning them
- With structured guidance, students develop stronger critical evaluation, ethical awareness, and responsible use
- AI supports idea generation and efficiency, but risks cognitive offloading if used uncritically
- The most robust competences emerge when AI is used as a scaffold, not a substitute

Despite contextual differences, a stable core of skills repeatedly appeared across classroom and desk research evidence.

✓ = Clearly identified and evidenced
(✓) = Indirect / supporting evidence

Although several competences show 4/4 presence across countries, Creativity was selected because it is uniquely transformed by AI exposure. Classroom and desk-research evidence demonstrate that AI fundamentally changes how students generate, refine, and own ideas, making creativity highly dependent on pedagogical framing. Unlike other 4/4 competences, creativity shows a clear cause–effect relationship between instructional design and learning outcomes. It therefore provides particularly strong explanatory value for understanding AI's impact on learning within WP2.

4) Final List of 5 Skills

During the partner meeting on 7 May 2026, all project partners reached a shared consensus on the final selection of the five key skills included in this report. The discussion was explicitly informed by the combined findings from national desk research, teacher feedback, and classroom observation data collected across the project. Based on this evidence, partners agreed that the project should focus specifically on soft skills that are pedagogically observable, sensitive to instructional design, and directly affected by students' exposure to AI in classroom practice.
As part of this consensus, digital competence and AI literacy were deliberately excluded from the final list, despite their strong presence in the data. Partners agreed that these competences primarily function as enabling or prerequisite skills, rather than as soft skills in themselves. While digital competence and AI literacy are necessary for engaging with AI tools, the evidence shows that they do not, on their own, capture the deeper changes in students' learning behaviour, reasoning, and interaction that the project aims to address.
The five selected skills were therefore chosen because they best reflect how AI reshapes students' cognitive, ethical, and social engagement with learning tasks. The agreement among partners was grounded in the consistency, recurrence, and explanatory power of these skills across countries and data sources. Further elaboration on the underlying evidence and the rationale for each selection will be developed in subsequent sections focusing explicitly on empirical justification and analytical interpretation.

Based on the cross-country analysis, the following five skills were identified as the most impacted by AI exposure:

1. Critical thinking
2. Problemsolving
3. Communication
4. Ethical judgment
5. Creativity

These skills collectively cover cognitive, digital, ethical, and creative dimensions and are supported by all seven partners' evidence.

5) Justification of Each Skill

Skill 1: Critical Thinking

Why selected:

Critical Thinking was selected because it is the most consistently and strongly affected competence across all partner countries and both data sources. Classroom implementations show that students initially tend to accept AI-generated responses without sufficient questioning, verification, or reflection. However, when structured tasks were introduced, students increasingly evaluated credibility, identified bias, and discussed limitations of AI outputs. Desk research confirms that AI systems can create an illusion of understanding, increasing the risk of cognitive offloading if critical evaluation is not explicitly trained. This makes Critical Thinking essential for preventing passive AI use and for supporting independent judgment in AI-rich learning environments. Across partners, this skill functions as the foundation for responsible, reflective, and epistemically sound learning.

Evidence:

Classroom implementation across Spain, Bulgaria, Türkiye, and Denmark (school partners) consistently shows that students initially tended to accept AI-generated answers without questioning accuracy, completeness, or bias. Observation sheets and teacher feedback document that, at the beginning of the interventions, many students relied on AI for quick answers or idea generation without reflecting on underlying reasoning. However, when structured activities such as source comparison, bias identification, debates, and guided reflection were introduced, students increasingly demonstrated critical evaluation of AI outputs and greater epistemic awareness.

In Türkiye (school partner), Critical Thinking emerged as one of the most frequently observed competences across multiple lessons. Students questioned AI responses, identified missing context, discussed stereotypes and bias, and proposed strategies such as verifying information and thinking independently before consulting AI. The consolidated competence matrix records high frequency and full success for critical thinking, supported by detailed teacher feedback describing a clear shift from trust to critical scrutiny.

Evidence from Bulgaria (school partner) highlights a similar progression. Teachers reported that students initially accepted AI answers at face value, but structured fact-checking and ethical discussion activities led to increased questioning, argumentation, and evaluation of credibility. Critical thinking was particularly visible during debates and dilemma-based activities, where students analysed AI-generated content and reflected on misinformation and societal impact.

Findings from Spain (school partner) show that teachers observed a reduction in students' independent reasoning when AI was used without guidance, reinforcing the need to explicitly foster critical thinking. Teacher feedback stresses that students asked fewer questions and showed less initiative when relying on AI, but that targeted pedagogical strategies helped re-establish analytical reflection and decision-making.

National desk research from Denmark, Spain, and Türkiye (non-school partners) strongly corroborates the classroom evidence. Across these reports, critical thinking is identified as a core competence needed to counter risks such as cognitive offloading, illusion of understanding, bias, and misinformation. The research consistently argues that without explicit focus on critical thinking, AI use may weaken students' independent judgment rather than strengthen learning

outcomes. This convergence across research and practice underpins the selection of Critical Thinking as a key competence most impacted by AI exposure.

Skill 2: Problem solving

Why selected:

Problem-solving was selected because AI fundamentally reshapes how students approach and engage with problems in learning situations. Across partner countries, evidence shows that AI can both support and undermine problem-solving processes, depending on pedagogical design. When AI is introduced without constraints, students tend to bypass productive struggle by outsourcing solution paths directly to AI, reducing persistence, strategic thinking, and ownership of the problem-solving process. Conversely, when tasks are explicitly staged and require students to define problems, explore solution strategies, and justify choices before or alongside AI use, problem-solving competence becomes more visible and more robust.
The comparative analysis indicates that problem-solving is particularly sensitive to AI exposure because it sits at the intersection of critical thinking, decision-making, and self-regulation. AI changes not only the speed of reaching a solution, but also the nature of the cognitive work involved. This makes problem-solving a key competence for understanding how AI alters learning processes, especially in tasks that involve inquiry, evaluation of alternatives, and goal-oriented reasoning.

Evidence:

Evidence from teacher notes and classroom observations across Spain, Bulgaria, and Türkiye shows recurring patterns in how AI affects students' problem-solving behaviour. Teachers consistently report that students initially rely on AI to provide ready-made solutions, especially in complex or open-ended tasks. In Spain, teacher feedback highlights that unscaffolded AI use often leads to reduced depth in students' reasoning and a tendency to accept the first plausible solution offered by AI, rather than exploring multiple approaches or reflecting on underlying assumptions.
In Bulgaria, problem-solving became more visible when tasks required collective discussion and justification of solutions. Teachers observed that students engaged more deeply with problems when they were asked to compare their own solution strategies with AI-generated suggestions and to explain why certain solutions were more appropriate than others. This indicates that AI can function as a catalyst for problem-solving when it is used as a comparative reference point rather than as a solution provider.
Classroom observation data from Türkiye provides particularly strong evidence of the conditional nature of problem-solving development. In lessons where AI use was delayed or restricted to later phases, students demonstrated higher levels of independent reasoning, persistence, and strategic exploration of solutions. Observation matrices show that students were more likely to articulate problem definitions, test alternative strategies, and revise their thinking after encountering AI feedback. When AI was introduced too early, however, observations document a clear reduction in students' engagement with the problem itself.
National desk research further supports these findings by framing problem-solving as a competence at risk of erosion through cognitive offloading. Across countries, the literature warns that while AI can increase efficiency, it may weaken students' capacity to engage in sustained problem analysis unless problem-solving is explicitly scaffolded. Taken together, the convergence between classroom data and desk research underlines that problem-solving is not automatically enhanced by AI, but is significantly reshaped by how AI is pedagogically framed, justifying its inclusion as a key

skill impacted by AI exposure.

Skill 3: Communication

Why selected:

Communication was selected because AI-supported learning environments consistently activate and transform communicative practices in the classroom. Across partner countries, AI use increases the frequency and importance of discussion, explanation, and justification, particularly when students are required to articulate reasoning, evaluate AI outputs, or negotiate shared conclusions. While communication is a well-established educational competence, the evidence shows that AI changes the conditions under which communication becomes necessary and meaningful in learning processes.
The comparative analysis demonstrates that communication is especially critical in AI-rich contexts because AI introduces new objects of dialogue: AI-generated answers, conflicting information, ethical dilemmas, and alternative solution paths. These situations require students to explain, argue, question, and reflect collectively. Communication therefore functions as a key mediating competence that enables other skills—such as critical thinking, ethical judgment, and problem-solving—to become visible and socially shared. This makes communication central to understanding how learning unfolds when AI is integrated into classroom practice.

Evidence:

Classroom implementation data from Bulgaria, Spain, and Denmark shows that communication is one of the most frequently observed competences during AI-supported activities, particularly in dialogic and collaborative task formats. In Bulgaria, teacher notes and observations highlight strong student engagement in discussion-based lessons, where AI outputs served as triggers for debate, ethical reflection, and collective reasoning. Teachers reported that students increasingly justified their opinions, challenged each other's interpretations, and articulated value-based arguments when discussing AI-generated content.
In Spain, communication became more visible when tasks required students to explain or defend their use of AI-generated information. Teacher feedback indicates that AI-supported preparation phases often led to richer oral discussions, especially when students were asked to compare their own ideas with AI suggestions and to explain discrepancies. However, teachers also noted that without explicit communicative requirements, AI use could reduce interaction, with students focusing on individual screen-based work rather than shared dialogue.
Evidence from Denmark reinforces the importance of communication as a competence activated through AI-related disruption and inquiry. Classroom observations document spontaneous whole-class discussions when students encountered AI outputs perceived as biased, oversimplified, or academically questionable. These moments triggered immediate questioning, explanation, and collective sense-making, making reasoning processes publicly visible. Communication thus emerged not merely as expression, but as a mechanism for negotiating meaning and authority in relation to AI.
Desk research across countries supports this interpretation by emphasising dialogue, argumentation, and democratic participation as central to human-centred AI use in education. Communication is framed as essential for maintaining human agency and shared understanding in technology-rich learning environments. The alignment between desk research and classroom evidence confirms that communication is consistently activated and pedagogically significant in AI-supported learning,

justifying its inclusion as one of the five key skills.

Skill 4: Ethical Judgment

Why selected:

Ethical Judgment was selected because AI use in education raises fundamental ethical questions related to bias, fairness, responsibility, privacy, and academic integrity. Classroom evidence shows that while ethical issues are initially challenging for students, guided discussions lead to deeper reflection and more responsible attitudes toward AI use. Desk research strongly supports the inclusion of ethical judgment, emphasizing that technical AI skills must be accompanied by value-based reasoning. This competence ensures that AI use remains human-centred and socially responsible. Ethical judgment also strengthens students' ability to understand the broader societal consequences of AI technologies.

Evidence:

Classroom implementation across Bulgaria and Türkiye (school partners) shows that ethical judgment became particularly visible when students engaged with questions of bias, fairness, misinformation, and responsibility in AI-generated content. Teachers reported that students initially found ethical concepts abstract and challenging, but that structured discussions, real-world examples, and dilemma-based tasks created meaningful opportunities for reflection. Observation sheets document students identifying biased AI responses, discussing societal consequences, and proposing strategies for responsible AI use, indicating that ethical judgment develops through guided engagement rather than spontaneous AI use.

In Bulgaria (school partner), ethical judgment was strongly connected to activities focused on misinformation and bias. Teacher feedback highlights that students progressed from simply recognising biased content to evaluating its potential impact on individuals and society. Ethical discussions during debates and group work strengthened students' ability to articulate value-based reasoning and to justify why certain AI uses may be problematic or unfair. These findings underline that ethical judgment is not an isolated competence, but one that emerges through interaction with critical thinking and communication.

Evidence from Denmark (school and non-school partners) reinforces the centrality of ethical judgment in AI-supported education. Danish desk research and policy-oriented sources consistently stress responsible AI use, academic integrity, transparency, and democratic values. The literature highlights that students must learn to reflect ethically on AI use, including issues of authorship, data use, bias, and trustworthiness, in order to maintain meaningful learning and societal responsibility. This emphasis is mirrored in classroom-oriented guidance that frames ethical reflection as an integral part of AI literacy and digital formation (*dannelse*).

In Spain (non-school partner), national desk research highlights ethical awareness as increasingly important in AI-mediated learning environments. The reviewed sources emphasise that AI integration raises concerns about over-reliance, reduced autonomy, and the need for human-centred values. Ethical judgment is therefore framed as essential for ensuring that AI supports inclusive, fair, and responsible educational practices rather than undermining them. This perspective aligns with classroom findings from other countries, confirming the cross-national relevance of ethical

competence.

Evidence from Türkiye (non-school partner) further strengthens the selection of ethical judgment. National policy documents and academic studies explicitly frame ethical and responsible AI use as a core educational priority, highlighting issues such as misinformation, privacy, fairness, and accountability. The convergence between policy, research, and classroom practice indicates that ethical judgment is one of the competences most clearly and consistently impacted by AI exposure in education. This cross-country alignment supports its inclusion as a key skill within WP2.

Skill 5: Creativity

Why selected:

Creativity was selected because they are uniquely and directly transformed by AI exposure. Classroom evidence shows that AI can both enhance and undermine creativity, depending on how and when it is introduced. When students generate ideas independently before engaging with AI, creativity, originality, and ownership increase; when AI is used too early, originality tends to decline. No other competence in the analysis shows such a clear dependency on pedagogical design. Creativity also acts as a bridge between critical thinking, digital competence, and innovation, making it especially relevant for understanding AI's transformative impact on learning processes.

Evidence:

Classroom implementation in Türkiye and Denmark (school partners) provides particularly strong evidence of how creativity and innovation are directly affected by AI exposure. Comparative lesson designs - especially activities where students brainstormed first without AI and then with AI as a sparring partner - showed that students were able to generate original ideas independently and subsequently use AI to refine, extend, or combine those ideas. Teachers observed that this sequencing strengthened students' sense of ownership and originality, whereas early use of AI risked narrowing ideational diversity and reducing independent ideation. These findings indicate that AI does not simply support creativity, but actively reshapes creative processes depending on pedagogical framing.

In Türkiye (school partner), creativity was clearly visible in Lessons 5 and 6, where students compared AI-free and AI-supported brainstorming. Observation sheets and the consolidated competence matrix recorded high frequencies of creative idea generation, combination, and refinement. Teacher feedback emphasised that students maintained creative agency when AI was positioned as a supportive tool rather than a source of ready-made ideas, highlighting innovation competence as an extension of creative thinking rather than a replacement for it.

Evidence from Spain (school partner) highlights the dual impact of AI on creativity. Teachers reported that AI facilitated faster idea generation and initial inspiration, particularly in writing and content-creation tasks. However, they also noted that students sometimes relied too heavily on AI suggestions, leading to reduced originality and personal expression. This reinforces the conclusion that creativity requires explicit scaffolding and reflective comparison between student-generated and AI-generated ideas in order to develop meaningfully.

Classroom findings from Bulgaria (school partner) further support this interpretation. Although

creativity was not always foregrounded as a separate skill, teachers observed that creative outcomes were strongest in tasks where students engaged in discussion, idea evaluation, and transformation of content rather than direct acceptance of AI outputs. This suggests that creativity and innovation emerge most clearly when AI use is embedded in reflective and collaborative learning designs rather than used as a shortcut.

National desk research from Denmark and Spain (non-school partners) corroborates the classroom evidence by framing creativity and innovation as future-oriented competences that are highly sensitive to AI use. The literature emphasises that generative AI can either enhance creative learning or undermine it through cognitive offloading, depending on instructional design. Several sources explicitly stress the importance of maintaining human agency, originality, and reflective evaluation when integrating AI into creative processes. This convergence between research and classroom data supports the inclusion of Creativityas a key competence most impacted by AI exposure within WP2.

6) Conclusion

Based on the cross-country analysis and the combined evidence from classroom implementation and national desk research, the findings show that students' learning processes are significantly shaped by how digital tools are integrated into teaching. The five selected skills—Critical Thinking, Digital Competence, Information Literacy, Ethical Judgment, and Creativity—emerge as particularly important because they reflect recurring patterns in students' behaviour, reasoning, and engagement across all partner countries.

A common trend observed is the risk of reduced independent thinking, superficial engagement, and uncritical acceptance of information when students are not adequately guided. Conversely, when learning activities are deliberately structured, students demonstrate stronger reflection, improved evaluation of information, increased responsibility, and deeper cognitive engagement. Teacher feedback consistently underlines the importance of explicit scaffolding, dialogue, and comparison activities in supporting these skills.

Overall, the results confirm that competence development does not occur automatically through exposure to new tools, but depends on intentional pedagogical design. Strengthening these five skills supports students' autonomy, judgment, and meaningful participation in contemporary learning environments and aligns closely with the objectives of WP2 and the broader educational focus on reflective, responsible, and student-centred learning.

In addition to the five selected key skills, the cross-country analysis shows that several other competences are repeatedly activated and observable in classroom practice and desk research across partner countries. These competences are not included in the final list because they either function as supporting skills, are context-dependent, or are less directly impacted by the introduction of new digital tools. Nevertheless, they play an important role in shaping learning processes and classroom dynamics.

Communication is one of the most frequently observed competences, particularly in classroom implementations in Spain, Bulgaria, and Denmark. Group discussions, debates, peer feedback, and

collaborative reflection tasks created strong opportunities for students to explain reasoning, justify choices, and engage in dialogic learning. Communication is especially visible in activities where students discuss credibility, ethical considerations, or alternative solutions. However, the analysis shows that communication is primarily mediated rather than transformed by digital tools; while such tools may facilitate expression, the underlying structure of the competence remains largely unchanged. For this reason, communication is considered highly relevant but not among the competences most impacted by exposure.

Collaboration also appears prominently across classroom implementations, particularly in group-based tasks such as joint brainstorming, evaluation of ideas, and decision-making activities. Teachers consistently reported high levels of student engagement and shared problem solving. However, similar to communication, collaboration functions mainly as a social learning condition rather than an AI-sensitive competence. Digital tools can intensify or support collaboration, but they do not fundamentally alter its nature. As a result, collaboration is treated as an enabling context rather than a core transformed skill.

Problem-solving and decision-making are visible across several countries, especially in tasks where students are required to choose between alternatives, evaluate solutions, or complete goal-oriented activities. Desk research confirms their relevance for future-oriented learning; however, classroom evidence shows that these competences are often indirectly addressed and strongly overlap with critical thinking and information literacy. They therefore function more as composite outcomes of other skills rather than as distinct AI-impacted competences.

Finally, competences such as adaptability, self-management, emotional intelligence, and resilience appear sporadically in national desk research, particularly in Denmark, but are less consistently observable in classroom data across countries. These competences are important for long-term personal development, yet they are less directly linked to concrete learning activities and more difficult to document within the scope of WP2 classroom implementations.

Overall, these competences contribute meaningfully to learning processes, but the cross-country analysis confirms that the five selected skills best capture the most direct, observable, and pedagogically relevant impacts of the current learning conditions addressed in WP2. The additional competences should therefore be understood as supportive and interacting layers that strengthen, but do not replace, the core focus of the final skill set.