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CHALLENGES FOR DEVELOPMENT OF AI LITERACY AMONG SCHOOL MATHEMATICS TEACHERS

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This article examines the development of artificial intelligence literacy among lower-secondary mathematics teachers from the perspective of educational science and sociology of education. The study starts from the assumption that AI literacy is becoming a new professional divider within the teaching profession. The key question is not how often teachers use AI tools, but whether they can transform AI-related uncertainty into pedagogical judgement, assessment decisions and responsibility for pupils' mathematical reasoning. The article uses an exploratory qualitative design based on four mathematics teacher narratives: two from Latvia and two from China. The narratives were structured around three open-ended questions concerning teachers' first encounters with pupils' AI use, changes in teaching or assessment practice, and perceived risks and limitations of AI in school mathematics. The aim of the article is to analyse AI literacy as an emerging professional divider among lower-secondary mathematics teachers and to show how this divide becomes visible in teachers' narrative accounts from Latvia and China. The analysis shows that AI use becomes visible mainly through homework, unusually polished written solutions, pupils' inability to explain their own answers and the weakening reliability of final written products as evidence of understanding. More developed AI literacy is expressed through process-oriented assessment, oral justification, comparison of solution methods, critical evaluation of AI-generated answers and pedagogical adaptation of AI-supported materials. Less developed forms are more defensive and focused on prohibition, technical control or external regulation, although they may still reflect justified concern about pupil dependence and loss of independent reasoning. The article argues that AI literacy should be understood as a technical, pedagogical, ethical and sociological competence. It shapes teachers' professional agency and may create new inequalities inside the teaching profession if institutional support, common school-level rules and teacher training remain uneven.

Keywords: AI literacy, mathematics teachers, lower-secondary education, generative artificial intelligence, sociology of education.

Mākslīgā intelekta pratības attīstības izaicinājumi skolas matemātikas skolotāju vidū

Rakstā analizēta mākslīgā intelekta pratības attīstība pamatskolas matemātikas skolotāju vidū izglītības zinātnes un izglītības socioloģijas skatījumā. Pētījuma sākumpunkts ir pieņēmums, ka MI pratība kļūst par jaunu profesionālās diferenciācijas faktoru skolotāju profesijā. Galvenais jautājums nav tas, cik bieži skolotāji izmanto MI rīkus, bet gan tas, vai viņi spēj MI radīto nenoteiktību pārvērst pedagoģiskā spriedumā, vērtēšanas lēmumos un atbildībā par skolēnu matemātisko domāšanu. Rakstā izmantots pētniecisks kvalitatīvs dizains, balstoties uz četriem matemātikas skolotāju naratīviem: diviem no Latvijas un diviem no Ķīnas. Skolotāju stāstījumi tika strukturēti ap trim atvērtajiem jautājumiem par pirmo saskari ar skolēnu MI izmantošanu, izmaiņām mācīšanas vai vērtēšanas praksē, kā arī par MI riskiem un ierobežojumiem skolas matemātikā. Raksta mērķis ir analizēt MI pratību kā jaunu profesionālās diferenciācijas faktoru pamatskolas matemātikas skolotāju vidū un parādīt, kā šī diferenciācija kļūst redzama Latvijas un Ķīnas skolotāju naratīvajos stāstījumos. Analīze rāda, ka MI izmantošana visbiežāk kļūst redzama mājasdarbos, neparasti glīti noformētos rakstiskajos risinājumos, skolēnu nespējā izskaidrot savas atbildes un rakstisko darbu kā izpratnes pierādījuma uzticamības mazināšanās procesā. Attīstītāka MI pratība izpaužas kā uz domāšanas procesu vērsta vērtēšana, mutisks pamatojums, risinājumu paņēmienu salīdzināšana, MI radītu atbilžu kritiska izvērtēšana un MI atbalstītu materiālu pedagoģiska pielāgošana. Mazāk attīstītas formas ir vairāk aizsargājošas un vērstas uz aizliegumu, tehnisku kontroli vai ārēju regulējumu, lai gan tās var atspoguļot pamatotas bažas par skolēnu atkarību un patstāvīgas domāšanas vājināšanos. Rakstā secināts, ka MI pratība jāuztver kā tehniska, pedagoģiska, ētiska un socioloģiska kompetence. Tā veido skolotāju profesionālo rīcībspēju un var radīt jaunas nevienlīdzības skolotāju profesijā, ja institucionālais atbalsts, kopīgi skolas līmeņa noteikumi un skolotāju apmācība saglabājas nevienmērīgi.

Atslēgvārdi: MI pratība, matemātikas skolotāji, pamatskolas izglītība, ģeneratīvais mākslīgais intelekts, izglītības socioloģija.

Introduction

Artificial intelligence (AI) has entered school education not only as a new set of digital tools, but also as a new condition under which teachers interpret learning, assessment and professional responsibility. In mathematics education this change is especially visible. Students can now use generative AI systems to explain algebraic procedures, solve word problems, check homework, produce step-by-step answers and prepare for tests. For teachers, this creates a double task: they have to understand the pedagogical value of AI and at the same time recognize when AI use replaces mathematical thinking rather than supporting it.

The problem is not limited to technology access. AI literacy is becoming a professional competence that influences how teachers plan lessons, design tasks, assess student work and communicate rules of acceptable AI use. UNESCO's AI competency framework for teachers defines teacher competence broadly, including a human-centred mindset, ethics of AI, AI foundations and applications, AI pedagogy and AI for professional learning (Miao, Cukurova 2024). This approach is important because it treats AI literacy not as a narrow technical skill, but as a combination of knowledge, judgement and pedagogical action.

AI literacy is therefore relevant for both educational science and sociology of education. In educational science, the key question is how teachers can use AI to support learning without weakening students' reasoning and independent problem-solving. In sociology of education, the key question is how uneven access to AI knowledge, training and confidence creates new differences inside the teaching profession. Teachers who understand AI tools, risks and pedagogical boundaries may gradually become more confident and institutionally influential. Teachers who lack this competence may become dependent on external rules, informal advice or avoidance strategies.

The concept of AI literacy has already been developed in interdisciplinary literature. Long and Magerko (2020) define AI literacy through competencies that allow individuals to critically evaluate AI technologies, communicate about them and use them effectively. Ng et al. (2021) describe AI literacy through the ability to know and understand AI, use and apply it, evaluate and create with it, and address ethical issues. These definitions are useful for school education because they show that AI literacy includes understanding, practical use and critical judgement. However, they do not fully explain how teachers experience AI literacy as part of everyday classroom work.

Teacher-focused research shows that this gap is significant. Sperling et al. (2024) argue that AI literacy has become a global educational topic, but it is still weakly developed in relation to teacher education and teachers' professional knowledge. Tan et al. (2025) also show that research on AI in teaching often pays more attention to classroom applications than to teachers' professional development needs. For mathematics teachers, this imbalance is especially problematic because AI use affects not only teaching resources, but also the meaning of homework, formative assessment and evidence of individual understanding.

The spread of generative AI has made assessment one of the most sensitive areas. A student may submit correct solutions without understanding the underlying mathematical reasoning. AI may also produce plausible explanations that hide errors, shortcuts or unsupported assumptions. Recent evidence from high school mathematics suggests that AI without appropriate safeguards may help students during assisted practice but weaken later independent performance when support is removed (Bastani et al. 2025). This does not mean that AI should be excluded from mathematics education. It means that teachers need enough AI literacy to distinguish support for thinking from substitution of thinking.

European and national policy contexts also increasingly place teachers at the centre of responsible AI use. The European Commission's ethical guidelines for educators emphasize that AI and data use in teaching and learning should be understood critically and ethically, especially by primary and secondary teachers (European Commission 2022). Latvia has recently launched a national AI programme in schools that aims by 2030 to ensure that students, teachers and educational leaders are skilled and responsible AI users, with emphasis on teacher professional development, safe use, methodological resources and AI literacy across education levels (Ministry of Education and Science of Latvia 2026).

China has also moved AI education into the policy agenda of primary and secondary schooling. In December 2024, the Ministry of Education issued guidance on enhancing AI literacy in primary and secondary schools, connecting AI education with innovation, problem-solving and systematic curriculum development (Ministry of Education of the People's Republic of China 2024). These policy developments do not make Latvia and China identical cases. They show, however, that in different educational systems teachers are increasingly expected to mediate between technological innovation, curriculum goals and students' actual learning practices.

This article focuses on lower-secondary mathematics teachers because this professional group stands at a difficult intersection. Mathematics teachers work with formal reasoning, procedural accuracy, problem-solving and assessment tasks that can be directly affected by AI tools. At the same time, lower-secondary students are old enough to use digital tools independently but often not experienced enough to evaluate AI-generated answers critically. The teacher's role therefore becomes more complex: mathematics instruction must include not only explanation of content, but also guidance on when AI use is legitimate, useful, misleading or academically dishonest.

The central argument of the article is that AI literacy differentiates mathematics teachers into more advanced and less advanced professional groups. This differentiation should not be understood as a simple opposition between "good" and "bad" teachers. It is better understood as an emerging professional divide between teachers who can integrate AI into pedagogical judgement and teachers who mainly experience AI as an external disruption. The difference may appear in lesson planning, homework policy, interpretation of student work, communication with pupils and confidence in making classroom-level decisions about AI use.

To examine this problem, the article develops an exploratory qualitative design based on narrative interview material. The empirical logic is intentionally small-scale and interpretive. The article compares four lower-secondary mathematics teacher narratives: two from Latvia and two from China, structured around three open-ended questions.

The research problem can therefore be formulated as follows: how does AI literacy shape the professional self-positioning of lower-secondary mathematics teachers when they face students' use of AI in learning and assessment? The aim of the article is to analyse AI literacy as an emerging professional divider among lower-secondary mathematics teachers and to show how this divide becomes visible in teachers' narrative accounts from Latvia and China. The article has three objectives: to clarify the concept of AI literacy in relation to teachers' professional knowledge; to identify classroom situations in which AI literacy becomes practically important for mathematics teachers; and to compare narrative tendencies in Latvian and Chinese teacher accounts.

The contribution of the article is conceptual and interpretive. It connects AI literacy with educational sociology by showing that teachers' unequal ability to understand and manage AI may become a new form of professional differentiation. It also contributes to mathematics education by shifting attention from AI tools as separate classroom resources to the teacher's judgement about learning, assessment and student responsibility. This perspective is important because the future of AI in school mathematics will depend not only on policy documents or software availability, but also on how teachers make sense of AI in everyday pedagogical practice.

Literature review

The concept of artificial intelligence literacy has developed from the broader discussion of digital competence, but it adds a specific problem that is especially important for teachers. Digital competence usually refers to the ability to use digital tools, communicate in digital environments and work with digital resources. AI literacy requires more than this. It involves understanding that AI systems generate, classify and recommend outputs on the basis of data and models, and that these outputs must be critically evaluated before they are used in professional practice. Long and Magerko (2020) define AI literacy as a set of competencies that enables individuals to critically evaluate AI technologies, communicate and collaborate with AI, and use AI as a tool in everyday contexts. Ng et al. (2021) also emphasize that AI literacy includes knowledge and understanding, practical use, evaluation and ethical awareness.

For school teachers, AI literacy is not only a technical skill. It is part of professional judgement. Teachers need to understand what AI tools can support, where their limits are, and how their use affects pupils' learning. UNESCO's AI Competency Framework for Teachers places this competence within a broader structure that includes a human-centred mindset, ethics of AI, AI foundations and applications, AI pedagogy and AI for professional learning (Miao, Cukurova 2024). The European Commission's ethical guidelines also stress that teachers should be able to engage with AI critically, ethically and pedagogically, especially in relation to transparency, fairness, privacy and human oversight (European Commission 2022). This means that AI literacy should not be understood as simple familiarity with digital tools. It includes the ability to make responsible decisions about when, how and why AI may be used in teaching.

This issue is particularly relevant in mathematics education. Mathematics teaching requires accuracy, logical sequence and attention to pupils' reasoning. AI tools can generate exercises, explanations, examples, feedback and alternative solution paths. These functions may support teachers' work, especially in lesson preparation and differentiation. At the same time, AI-generated mathematical content can be formally convincing but pedagogically problematic. It may skip reasoning steps, use methods that pupils have not yet learned, produce unclear notation or give an answer without supporting conceptual understanding. Therefore, mathematics teachers need not only to use AI tools, but also to verify, adapt and explain AI-generated content.

The relation between AI literacy and subject teaching can be understood through the TPACK framework. Mishra and Koehler argue that meaningful technology integration depends on the interaction between technological knowledge, pedagogical knowledge and content knowledge (Mishra, Koehler 2006). For mathematics teachers, this interaction is central. A teacher may know how to prompt an AI tool, but this does not guarantee that the generated material is mathematically suitable or pedagogically useful. AI literacy becomes professionally meaningful only when it is connected with the teacher's subject knowledge and ability to support mathematical thinking.

Existing research on AI in education has often focused on applications, platforms and possible benefits, while the professional role of teachers has received less attention. Zawacki-Richter et al. (2019) note that educators are underrepresented in research on artificial intelligence applications in education. This is a significant limitation because the classroom use of AI is not determined by technology alone. It depends on how teachers interpret AI tools, how they respond to pupils' use of them, and how they set boundaries between assistance, explanation and independent learning.

From a sociological perspective, AI literacy may become a new source of differentiation within the teaching profession. Teachers do not encounter AI from equal positions. Some teachers have stronger digital experience, better institutional support, more time for experimentation or wider professional networks. Others may experience AI as an additional pressure, a source of uncertainty or a threat to established teaching routines. Bourdieu's (1986) concept of capital is useful here because professional advantage is not limited to formal qualification; it also includes cultural, social and symbolic resources that help actors use new opportunities more effectively. In this sense, AI literacy may function as a new form of professional capital.

This differentiation does not mean that teachers with higher AI literacy are automatically better teachers. The issue is more complex. A teacher who actively uses AI may save time, prepare more varied tasks and reflect on new forms of feedback. However, the same teacher may also become overdependent on generated content. A teacher who uses AI cautiously may preserve strong pedagogical control, but may also lose opportunities for professional development if AI becomes part of pupils' everyday learning environment. Therefore, the important question is not whether teachers are simply "for" or "against" AI, but how they understand its role in relation to mathematical knowledge, pupils' independence and their own professional authority.

Research on mathematics teachers shows that attitudes towards AI are not uniform. Wijaya et al. (2024) identify different profiles of mathematics teachers in relation to AI literacy, trust in AI, AI dependency and twenty-first-century skills. This supports the view that mathematics teachers may differ not only in their level of technical competence, but also in confidence, trust, dependence and readiness to integrate AI into professional practice. Such differences are important because they may shape how teachers respond to the same educational change.

Policy contexts also influence teachers' interpretation of AI. In Latvia, digital transformation is connected with broader education development and the strengthening of digital skills within the education system (Cabinet of Ministers of Latvia 2021). In China, AI education has been more explicitly linked with national modernization, innovation and the development of future-oriented school education (Ministry of Education of the People's Republic of China 2024). These contexts differ, but they create similar professional pressure: teachers are expected to understand AI, respond to pupils' use of AI tools and adapt teaching practices without losing the educational meaning of the subject.

The reviewed literature shows that AI literacy among mathematics teachers should be understood as a technical, pedagogical, ethical and social competence. It concerns tool use, but also professional judgement, responsibility and status within the teaching profession. This is why teachers' own explanations are important. Their narratives can show not only whether AI is used, but how its use is justified, limited and connected with everyday teaching decisions.

Research methodology

The article uses a qualitative exploratory research design. This approach was chosen because the study focuses on how mathematics teachers understand artificial intelligence literacy, how they describe their own use of AI tools, and how they evaluate the risks and limitations of AI in school education. Accordingly, the analysis identifies professional meanings and tendencies that appear in teachers' answers rather than measuring AI literacy statistically (Creswell, Poth 2018; Patton 2015).

The empirical material consists of answers provided by four mathematics teachers: two teachers from Latvia and two teachers from China. All teachers are connected with school mathematics teaching. The comparison between Latvia and China is used not for statistical generalisation, but for identifying similarities and differences in the way teachers explain the role of AI in mathematics education.

The same three open-ended questions were used for all teachers:

- When and how did you first notice that pupils were using AI tools for homework, tests or mathematical problem-solving?
- Has pupils' use of AI changed your approach to homework, assessment or explanation of mathematical topics?
- How should a mathematics teacher respond to pupils' use of AI: prohibit it, control it, partially allow it, teach pupils to verify AI-generated answers, or combine these approaches?

These questions were selected because they correspond to the practical sequence through which AI literacy becomes visible in school mathematics: first, teachers recognise signs of pupils' AI use; second, they reconsider homework, assessment and explanation; third, they define responsible boundaries between assistance, control and independent mathematical reasoning. The questions are open-ended in order to allow teachers to answer in their own words and to show how they connect AI with everyday mathematics teaching.

The unit of analysis is the teacher's answer as a professional narrative. Each answer is treated not only as a statement of opinion, but also as a way in which the teacher explains his or her professional position in relation to AI (Kvale, Brinkmann 2015). The analysis therefore considers how teachers describe their own readiness, how they justify the use or non-use of AI tools, and where they draw boundaries between technological support and the teacher's pedagogical responsibility.

Following the logic of thematic analysis (Braun, Clarke 2006), the answers were analysed according to three thematic blocks. The first block concerns how teachers recognise pupils' AI use in homework, tests and mathematical problem-solving. The second block concerns changes in teaching and assessment practice, including homework design, explanation of mathematical concepts, checking pupils' work, oral justification and feedback. The third block concerns teachers' response strategies and perceived risks, including prohibition, control, partial permission, verification of AI-generated answers, pupils' dependence on ready-made solutions, ethical issues and the possible change of the teacher's role.

The analysis was carried out in several stages. First, the answers were read separately in order to preserve the internal logic of each teacher's position. Second, key themes were identified in each answer according to the three research questions. Third, the Latvian and Chinese answers were compared across the same thematic blocks. This made it possible to identify not only national or contextual differences, but also broader professional tendencies among mathematics teachers.

Special attention was paid to the distinction between more advanced and less advanced forms of AI literacy. This distinction was not based only on whether a teacher uses AI tools frequently. A more advanced form of AI literacy was understood as the ability to combine tool use with critical verification, mathematical accuracy, pedagogical purpose and awareness of risks. A less advanced form was understood as either limited understanding of AI possibilities or uncritical reliance on AI-generated content. Therefore, the analysis focused on the quality of professional judgement rather than on the simple frequency of AI use.

The study has several limitations. The number of teachers is small, and the results cannot be generalised to all mathematics teachers in Latvia or China. The article also does not compare national education systems as whole systems. The analysis is limited to showing how different mathematics teachers describe AI literacy and how their answers reveal tendencies in professional understanding, confidence, caution and responsibility.

Despite these limitations, the chosen methodology is consistent with the article's aim. It allows AI literacy to be examined not only as a formal competence, but as part of teachers' professional reasoning. In mathematics education this is especially important because AI tools may support explanation, task preparation and feedback, but they cannot replace the teacher's responsibility for mathematical accuracy, pupils' understanding and the development of independent thinking.

Results of the study

The analysis of the teacher narratives shows that AI literacy among lower-secondary mathematics teachers becomes visible not only through direct use of AI tools, but also through the way teachers interpret pupils' work, redesign assessment, define responsibility and understand their own professional role. The narratives reveal different degrees of readiness, caution and pedagogical transformation. The distinction between more developed and less developed forms of AI literacy is therefore expressed not as a simple difference between teachers who use AI and teachers who do not use it, but as a difference in professional judgement.

In the first Latvian narrative, AI use became visible through changes in pupils' homework. Several pupils submitted very similar solutions, written in unusually precise and academic language. In some cases, the solutions contained methods, terms or forms of explanation that had not been discussed in class. The teacher also noticed that some pupils were unable to explain the mistakes that appeared in their own submitted work. This made the teacher suspect that the final answer did not always represent the pupil's actual mathematical understanding.

The teacher's response was not limited to discipline or prohibition. She began by discussing the situation with pupils and asking how they had arrived at the submitted solutions. Some pupils admitted that they had used AI tools to check their answers or to obtain an example of a solution. This moment is important because it shows the teacher's movement from suspicion to pedagogical interpretation. AI was no longer treated only as a possible form of academic dishonesty. It became a new condition that had to be understood and managed inside the learning process.

The teacher then changed her approach to assessment. She began to pay more attention not only to the final answer, but also to the pupil's reasoning. Pupils were asked to write explanations of how they reached a solution, to explain one task orally in class or to analyse an AI-generated solution and identify whether it was correct. In geometry, the teacher started asking pupils to compare different solution methods and justify which one was more effective. In this way, AI indirectly pushed the teacher to strengthen argumentation, explanation and critical evaluation in mathematics learning.

This narrative demonstrates a relatively developed form of AI literacy. The teacher does not present AI as a tool that should be completely excluded from school mathematics. At the same time, she does not accept AI-generated answers as sufficient evidence of learning. Her position is based on the distinction between AI as support for understanding and AI as substitution of reasoning. The central requirement remains that the pupil must be able to explain, justify and defend the mathematical result.

The second Latvian narrative also begins with changes in homework. Completed assignments became longer, more carefully presented and more often contained correct answers. At the same time, they were not always fully edited and still included formatting inaccuracies. This combination suggested that pupils might be using AI or other digital tools to obtain correct solutions, while not always understanding or carefully checking the submitted work.

The teacher's first response was practical. Knowing that pupils often prefer copying the task text into a computer rather than working manually, he tried to write tasks by hand on ordinary notebook paper and give pupils relatively little time to complete the assignment. The aim was to reduce the possibility of simple copying and pasting and to see whether pupils could work with the mathematical content independently. At first, not all pupils managed to complete the tasks quickly. However, the teacher soon observed that pupils adapted and learned how to transfer even handwritten text into digital form.

This narrative reveals an important tendency: technical control measures have limited effectiveness. When one route of AI-supported behaviour is restricted, pupils may quickly find another route. The issue therefore cannot be reduced only to the format of the task, access to devices or time limits. It concerns pupils' responsibility, motivation and understanding of what it means to learn mathematics. The teacher is uncertain whether pupils' behaviour should be explained by laziness, indifference or simple convenience, but his narrative clearly shows that AI makes the boundary between independent work and assisted work more difficult to identify.

At the same time, this teacher does not support a complete ban on AI. He argues that prohibition is impossible in practice. Instead, pupils should understand that they remain responsible for every submitted task, even when AI has been used. The answer belongs to the pupil, not to the tool. This point is especially important in mathematics, where a correct final result does not necessarily prove understanding. Pupils must still be able to explain the logic of the solution, because AI will not always be available and cannot replace personal mathematical competence.

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The Chinese teacher narratives show partly similar concerns, but they place stronger emphasis on the connection between AI, teacher readiness and classroom organisation. In one narrative, AI is described primarily as a resource that can support mathematics teaching when it is used with clear pedagogical purpose. The teacher associates AI with the preparation of examples, alternative explanations and differentiated tasks for pupils with different levels of mathematical readiness. AI is not presented as a replacement for instruction, but as an additional source of teaching materials that can help present the same mathematical idea in different ways. In the first Chinese account, the teacher describes using AI to prepare alternative explanations for algebraic transformations, to create several variants of the same task and to adapt examples for pupils who need slower step-by-step support. The teacher also stresses that AI-generated solutions are compared with the method used in class before they are shown to pupils.

This position reflects a more active understanding of AI literacy. The teacher sees AI literacy not only as the ability to operate a tool, but as the ability to evaluate whether the generated content is mathematically correct and pedagogically appropriate. In mathematics education, this distinction is essential. A generated solution may be formally correct, but unsuitable for a particular class if it uses methods that pupils have not yet studied or if it skips important reasoning steps. Therefore, the teacher's professional task is to check, simplify, adapt and explain AI-generated material before it enters classroom practice.

The same narrative also shows that AI can be used to support weaker pupils. It can generate additional exercises, provide step-by-step explanations or offer another formulation of a concept that pupils did not understand during the lesson. However, this support is not automatic. The usefulness of AI depends on whether the teacher can connect it with the lesson objective and with pupils' actual difficulties. In this sense, AI literacy appears as part of pedagogical and subject knowledge rather than as a separate digital skill.

The second Chinese narrative is more cautious. AI is recognised as an important and probably unavoidable part of contemporary education, but the teacher places stronger emphasis on risks than on opportunities. The main concern is that pupils may become dependent on ready-made answers and lose the habit of working through mathematical problems independently. In this account, AI is not rejected as such, but it is associated with a possible weakening of effort, concentration and responsibility. The teacher gives the example of pupils copying a sequence of AI-generated steps for equations or word problems while being unable to explain why a transformation is valid. For this reason, the teacher prefers short in-class checks, oral questions and comparison between an AI answer and the solution procedure demonstrated during the lesson.

This teacher's understanding of AI literacy is closer to risk awareness than to active pedagogical integration. AI literacy means knowing that AI can make mistakes, that its explanations may be incomplete, and that pupils should not trust generated answers automatically. The teacher is particularly concerned that pupils may confuse fluent explanation with correctness. In mathematics, an answer that looks convincing may still contain hidden errors or use reasoning that is not appropriate for the pupil's level.

The cautious Chinese narrative also shows uncertainty about the teacher's changing role. The teacher recognises that AI affects homework, assessment and classroom control, but does not describe a fully developed strategy for integrating AI into teaching. The expected solution is connected with clearer rules, external guidance and institutional support. This indicates that the teacher experiences AI partly as an external pressure that requires regulation from the school or education system.

The comparison of the narratives shows that the most important difference is not the national context alone. The Latvian and Chinese cases reveal similar tensions: pupils can use AI to obtain answers; teachers struggle to determine whether the pupil understands the solution; homework

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becomes less reliable as evidence of independent learning; and teachers need new strategies for explanation, verification and assessment. The difference lies in the quality of pedagogical response. The following table summarises the main tendencies identified in the teacher narratives.

Table 1.

Main tendencies in teacher narratives on AI literacy in mathematics education

Teacher narrative	Initial perception of AI	Main pedagogical response	Dominant risk identified	Form of AI literacy
Latvian teacher 1	AI becomes visible through similar homework, unusually precise language and unexplained mistakes	Shift to explanation, oral justification, comparison of solution methods and analysis of AI-generated answers	Correct answers may hide lack of understanding	More developed: process-oriented and reflective
Latvian teacher 2	AI becomes visible through longer, neater and more correct homework	Attempts to limit copying, followed by emphasis on pupil responsibility for submitted work	Pupils adapt to control measures and may rely on AI instrumentally	Moderately developed: realistic but mainly control-oriented
Chinese teacher 1	AI is seen as a possible teaching resource for alternative explanations, algebraic examples and task variation	Use of AI for examples, explanations, differentiated tasks and support for weaker pupils, with teacher verification against classroom methods	AI-generated content may be mathematically correct but pedagogically unsuitable for the pupils' current level	More developed: integrative, selective and linked to mathematical explanation
Chinese teacher 2	AI is seen as unavoidable but risky when pupils copy solution steps without understanding them	Emphasis on caution, oral checks, comparison with class methods, critical checking and need for external guidance	Dependence on ready-made answers, copied reasoning and weakening of independent mathematical effort	Less developed but reflective: risk-aware, defensive and boundary-oriented

Source: compiled by the authors on the basis of teacher narratives.

The table shows that more developed AI literacy is not defined by frequent or enthusiastic use of AI. It is defined by the teacher's ability to connect AI use with mathematical reasoning, task design, pupil explanation and critical verification. In contrast, less developed AI literacy appears when the teacher recognises the risks of AI but has fewer strategies for transforming these risks into teaching and assessment practices.

Across the narratives, three tendencies are especially important. First, AI changes the meaning of homework. Homework can no longer be interpreted simply as evidence of independent work, because pupils may use AI to generate correct or partially correct solutions. Teachers therefore need additional ways to check understanding, such as oral explanation, written reasoning, comparison of methods and classroom discussion.

Second, AI makes the final answer less important than the process of reasoning. In mathematics education this is a major shift. If AI can produce an answer, the teacher has to focus more strongly on how the pupil understands the path to that answer. The narratives show that more developed teachers respond by strengthening explanation, justification and error analysis. This does not remove the importance of correct answers, but it changes their evidential value.

Third, AI literacy becomes a form of professional differentiation among teachers. Teachers with more developed AI literacy are able to treat AI as a pedagogical problem that can be worked into teaching practice. They ask how AI affects reasoning, assessment and responsibility. Teachers with less developed AI literacy are more likely to experience AI as a disruption that must be controlled or regulated externally. This does not mean that they are professionally weaker in general. It means that AI creates a new area in which teachers' confidence, judgement and access to professional support become unequal.

The results therefore support the central argument of the article. AI literacy divides mathematics teachers not by the simple fact of tool use, but by their capacity to preserve mathematical reasoning when AI makes answers easier to obtain. In both Latvia and China, this divide appears in everyday classroom practices: homework, copying, checking, explaining and assessing.

Discussion

The results suggest that AI literacy should be treated as a professional condition that reorganises the relation between teaching, assessment and responsibility. In mathematics education this is especially important because the object of learning is not only a correct answer, but also the reasoning that makes the answer meaningful. Generative AI exposes the gap between the appearance of mathematical competence and its actual presence: a pupil may submit a plausible solution while being unable to reproduce or justify it independently.

This finding corresponds to the broader argument that AI in education should not be understood only through efficiency, automation or personalisation. Holmes and Tuomi emphasise that educational AI is often discussed on the basis of narrow assumptions about what education is and what AI systems can do (Holmes, Tuomi 2022). The present study supports this view at the level of school mathematics. The central question is not whether AI can produce useful outputs, but whether its use preserves or replaces pupils' mathematical action.

The idea of hybrid human-AI learning is useful here. Molenaar argues that productive educational uses of AI should combine human and artificial intelligence rather than replace human judgement (Molenaar 2022). In the analysed narratives, the more developed teacher positions follow this logic. AI may help with examples, explanations or checking, but the teacher remains responsible for evaluating the content, adapting it to the class and ensuring that pupils can explain the reasoning themselves.

Assessment is the field where this professional judgement becomes most visible. Teachers cannot always reconstruct how a homework solution was produced. However, they can design assessment situations that require pupils to demonstrate reasoning through oral explanation, comparison of methods, error analysis or reflection on an AI-generated answer. Bearman and Ajjawi's argument that education in an AI-mediated world requires working with uncertainty is relevant here (Bearman, Ajjawi 2023). The task is not to remove uncertainty completely, but to make learning evidence richer than a final written product.

The findings also show why prohibition is a weak long-term strategy. Research on generative AI and academic integrity stresses that institutions need clearer rules and redesigned assessment rather than relying only on detection or punishment (Cotton et al. 2024; Gruenhagen et al. 2024). In school mathematics, this is particularly important because pupils are still developing habits of effort, responsibility and independent thinking. A ban may simplify formal control, but it does not teach pupils how to use AI critically or when not to use it.

At the same time, the article does not support an optimistic view of AI as an automatically beneficial learning tool. Kasneci et al. (2023) show that large language models create both opportunities and risks for education, including errors, overreliance and problems of academic integrity. The mathematics context makes these risks sharper because correct-looking solutions can hide missing reasoning. Bastani et al. (2025) also demonstrate that generative AI without safeguards may improve assisted practice while weakening later independent performance in high school mathematics. This makes the design of pedagogical guardrails essential.

The sociological implication is that teachers are not equally prepared to respond to this situation. AI literacy may become a form of professional capital. Teachers with stronger digital confidence, subject-specific judgement and institutional support can convert AI-related uncertainty into pedagogical action. Teachers without these resources may experience the same situation mainly as loss of control. This extends Bourdieu's (1986) view that advantage in professional fields depends not only on formal position, but also on access to cultural, social and symbolic resources.

Recent research supports this interpretation. Chounta et al. (2022) found that Estonian K-12 teachers recognised the possible usefulness of AI but often had limited knowledge of how it could support their practice. Sperling et al. (2024) show that AI literacy in teacher education remains weakly connected with teachers' professional knowledge. Tan et al. (2025) further identify an imbalance between research on AI applications in teaching and research on teachers' professional development needs. These findings explain why teacher readiness cannot be solved only by policy declarations or access to tools.

Teacher education should therefore move beyond generic digital-skills training. For mathematics teachers, AI literacy should include the analysis of AI-generated mathematical errors, the redesign of homework, methods of oral justification, discussion of acceptable AI assistance, and the development of tasks where pupils must compare, correct and explain solutions. Prilop et al. (2025) also emphasise the need for formal professional development and collaborative learning in teacher education in relation to generative AI.

The article also contributes to K-12 AI literacy research. Systematic reviews show that AI literacy at school level includes concepts, applications, ethics, problem-solving and critical reflection (Casal-Otero et al. 2023; Lee, Kwon 2024). The present study adds that pupil AI literacy depends on teacher AI literacy. Pupils cannot be expected to use AI responsibly if teachers are unable to define learning purposes, boundaries and forms of accountability.

For mathematics education, this means that AI literacy is closely connected with task design. Walkington et al. (2026) show that generative AI can support mathematics teachers in posing problems related to students' interests, but only when teachers evaluate and adapt the generated tasks. This confirms the article's interpretation: AI literacy is not prompt-writing alone. It is the ability to decide whether a task is mathematically valid, age-appropriate, aligned with the curriculum and useful for reasoning.

The comparative element of the article should be interpreted cautiously. The Latvian and Chinese narratives do not justify general conclusions about national systems, but they show that similar professional tensions can appear in different contexts. In both cases, the central difficulty is the same: AI makes answers easier to produce, while mathematics education still requires pupils to understand and justify the reasoning behind them.

The main theoretical implication is that AI literacy should be understood as both an educational and a sociological category. Educationally, it concerns the preservation of reasoning, explanation and meaningful assessment. Sociologically, it concerns unequal professional agency within the teaching profession. A teacher who can transform AI-related uncertainty into pedagogical action occupies a different professional position from a teacher who experiences the same uncertainty mainly as disruption. This is the professional divide at the centre of the article.

Conclusion

The article has examined AI literacy as an emerging professional divider among lower-secondary mathematics teachers. The main finding is that this divide should not be understood as a simple distinction between teachers who use AI and teachers who do not. The article shows a new line of professional differentiation: teachers differ in their capacity to preserve mathematical reasoning, explanation and responsibility under conditions of generative AI. Teachers with more developed AI literacy connect AI use with task design, assessment and pupils' justification of solutions, while teachers with less developed AI literacy may recognise real risks but have fewer strategies for transforming them into pedagogical practice.

The teacher narratives from Latvia and China show that AI enters school mathematics through ordinary classroom situations rather than through formal innovation projects. Homework, copied reasoning and pupils' inability to explain answers become indicators of a deeper shift: the final written product is no longer enough to prove understanding. This pushes mathematics teachers to strengthen oral justification, comparison of solution methods and critical evaluation of AI-generated answers.

The study also shows that prohibition alone is not an effective pedagogical response. Pupils may quickly adapt to technical restrictions, while teachers remain uncertain about the boundary between legitimate assistance and substitution of thinking. Therefore, responsible AI use in mathematics education requires more than rules against cheating. It requires tasks and assessment practices that make reasoning visible. A pupil who uses AI should still be able to explain the solution, justify the method, identify possible errors and take responsibility for the submitted work.

From the perspective of educational science, the article contributes to the understanding of AI literacy as part of teachers' pedagogical and subject knowledge. In mathematics, AI literacy is not limited to knowing how to operate digital tools. It includes the ability to evaluate whether AI-generated content is mathematically correct, pedagogically suitable and appropriate for pupils' level of understanding. From the perspective of sociology of education, the article shows that AI literacy may become a new form of professional capital. Teachers who have stronger digital confidence, institutional support and reflective capacity may gain more agency, while others may experience AI mainly as an external pressure or loss of control.

The exploratory character of the study should also be emphasised. The article does not measure AI literacy statistically and does not claim to generalise about all mathematics teachers in Latvia or China. Its value lies in identifying tendencies that appear in teachers' narratives. These tendencies show that AI literacy is becoming a practical condition of professional work: it affects how teachers interpret pupils' answers, organise assessment, communicate responsibility and preserve the educational meaning of mathematical reasoning.

Future research should expand the number of teacher narratives and compare them with actual classroom tasks, assessment materials and school-level AI policies. It would also be useful to examine whether similar professional divides appear in other subjects. The central contribution of this article is to show that AI literacy is not only a response to a new technology, but a condition for maintaining the educational meaning of mathematical reasoning in the age of generative AI.

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