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INFORMATICS EDUCATION IN THE AGE OF AI LESSONS FROM AUSTRIA’S NEW UPPER-SECONDARY CURRICULUM

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Abstract

The rapid rise of artificial intelligence has renewed the question of what students need to understand about computational systems and what role informatics should play in general education. Austria’s response is a new upper-secondary subject, “Informatics and AI,” extending the existing compulsory informatics provision by one weekly lesson and distributing instruction across grades 9–11. This outcome followed a contested process in which informatics came close to being merged into a broader subject combining digital and media education. The resulting standalone subject combines broad informatics foundations with explicit attention to AI, treating AI as an integral subfield of informatics rather than as a digital application skill. The reform nevertheless remains incomplete: compulsory informatics still ends before the final school year and is not an independent subject in the final school-leaving examination. Drawing on the Austrian experience, we discuss lessons for establishing informatics as a visible discipline, designing curricula, and shaping educational policy in the age of AI.

1 Introduction

The rapid diffusion of artificial intelligence (AI), and generative AI in particular, has renewed educational attention to computational systems. AI literacy has become an important educational goal, encompassing not only AI use, but also an

understanding of its foundations and reflection on its societal and ethical implications [22, 23]. At the European policy level, *DigComp 3.0* similarly integrates AI competence throughout the *European Digital Competence Framework* [6].

Yet, using computational systems is not the same as understanding them. In public debate, informatics is still often equated with the use of digital tools; yet using office software or a chatbot has about as much to do with informatics as touch-typing has with literature. Informatics is part of general education because it provides concepts and methods for representing information, abstracting problems, designing algorithms, constructing computational systems, and reasoning about their capabilities and limitations [2, 12, 21]. Its contribution is not familiarity with technology, but a discipline of thought: students learn to formulate procedures precisely, construct formal systems, and reason about their properties. AI makes this distinction visible: the educational challenge is not merely to use AI-enabled tools, but to understand their capabilities, limitations, and outputs.

The rise of AI, therefore, creates both an opportunity and a challenge for informatics education. It brings renewed attention to the discipline while raising a fundamental curricular question: does general education in a world in which AI increasingly performs computational tasks still require informatics as a visible field, or can this role be assumed by broader approaches to digital and media education? In Austria, this was not hypothetical: until late 2025, the plan was to merge informatics with media education into a joint subject.

We argue that informatics should be a compulsory, independent subject, beginning in lower-secondary education, continuing throughout upper-secondary education, and being available for the final school-leaving examination. This requires sustained instructional time rather than isolated exposure; as a curricular orientation, we consider at least two weekly lessons necessary to address the breadth of the discipline and develop its concepts progressively. The *Informatics Reference Framework for School* similarly calls for informatics to have a status and standing comparable to language and mathematics [5]. Our central thesis is:

The rise of AI does not reduce the need for informatics; it makes that need more visible.

In Austria, however, AI was also used to argue for the opposite conclusion. Which of the two positions prevails is decided not only by the strength of the arguments but also by advocacy.

Austria's recent upper-secondary curriculum reform provides an opportunity to examine this tension. We place the reform in its European context, examine the debate about the role of informatics in schools, and show how the resulting standalone subject, "Informatics and AI," combines broad informatics foundations with explicit attention to AI. Measured against the objectives above, the Austrian reform represents a partial success.

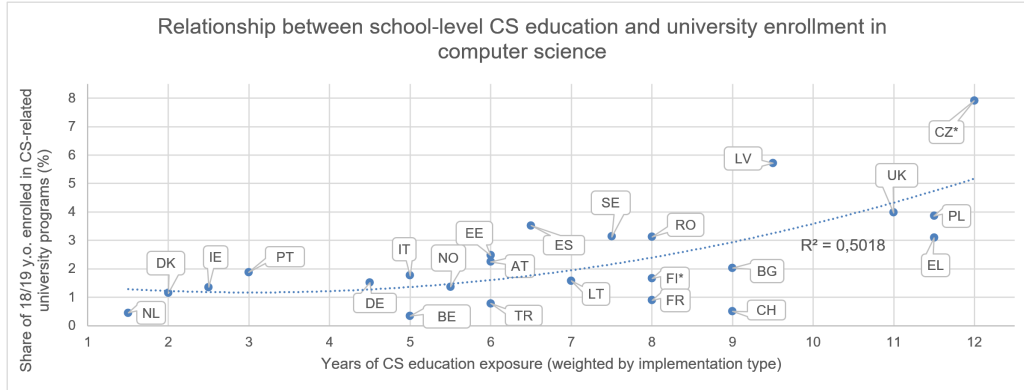


Figure 1: Results from Bollin et al. [3], relating weighted informatics exposure to enrollment in informatics-related university programs across 24 European countries. The fitted trend ($R^2 = 0.5018$) accounts for about half of the variation in enrollment. Exposure is weighted by implementation type, with integrated instruction counting less than standalone compulsory instruction. Asterisks mark countries where mixed forms required exposure to be estimated.

2 Background

2.1 Informatics Education in Europe

Informatics education in Europe has developed substantially over the past decade, but implementation still differs across countries and educational levels. Informatics may be taught separately, integrated into other subjects, or addressed cross-curricularly [9]. European policy increasingly recognizes informatics as a distinct field of education rather than merely the use of digital technologies. The *Council Recommendation* of 2023 calls for high-quality informatics or computational thinking education from the beginning of compulsory education, with clear learning objectives, dedicated time, assessment, and appropriately qualified teachers [7]. More recently, the European Commission’s *Guidelines for Teaching Informatics* distinguish informatics from the use of digital technology, and emphasize concepts and practices for understanding how digital technology works [8].

The form and extent of informatics education matter. Across 24 European countries, mandatory informatics was positively associated with enrollment in informatics-related university programs, while no significant association was found for integrative or optional models [3]. Greater compulsory exposure across grades was also associated with higher enrollment (Figure 1). While these observational findings do not establish causality, they support the case for informatics education that is compulsory, sustained across grades, and allocated sufficient curricular time.

Switzerland illustrates a possible time lag: despite substantial school-level exposure, informatics enrollment remains modest, as affected cohorts may not yet have reached higher education. In 2024, informatics was further upgraded from an obligatory to a foundational subject (*Grundlagenfach*) in upper-secondary academic education [20]. Such time lags also argue against delaying curricular reform if future cohorts are to benefit from it.

This European context frames the Austrian reform: the question was not whether informatics should be taught, but whether it receives a distinct curricular place, sufficient instructional time, and continuity across grades.

2.2 The Austrian Curriculum Reform

The upper-secondary reform followed substantial changes in lower-secondary education. In 2022, Austria introduced “Digital Education” (*Digitale Grundbildung*) as a compulsory subject in grades 5–8 (ISCED 2), following its introduction as a mandatory curriculum in 2018 [1, 10]. The subject combines informatics-related content, digital application skills, and media education, reflecting the technological, societal, and interaction-oriented perspectives of the *Frankfurt Triangle* [4]. Its rapid introduction posed challenges for teacher preparation, as many teachers had limited prior training [10].

At upper-secondary level (ISCED 3), compulsory informatics was limited to two weekly lessons in grade 9, with none in grades 10–12 [16]. Informatics could continue as an elective, but did not provide a common education for all students.

The reform process changed direction several times. In 2024, plans initially envisaged six to eight weekly lessons in total across grades 9–12. A complete curriculum based on the *Informatics for All* reference framework had been developed before this allocation was reduced to four weekly lessons. In 2025, the direction changed more fundamentally: informatics and media education were to be combined into a joint subject, discussed under titles such as “Media Education and Informatics” and “Digital Education,” with the *Frankfurt Triangle* as a common framework. Disagreement over the role and scope of informatics eventually led to the development group’s dissolution in late 2025.

In early 2026, the process restarted with a new group for the standalone subject “Informatics and AI.” Its politically chosen title remained contested within the group and the informatics community, who regarded AI as part of informatics rather than a separate discipline. The reform makes the subject compulsory in grades 9–11, with one weekly lesson per grade instead of two in grade 9 only. Media education received its own curricular space through the compulsory subject “Media and Democracy.” The changes take effect in September 2027, with “Informatics and AI” introduced progressively by grade [17]. Reaching this outcome required more than curriculum development.

2.3 Advocating for Informatics

Throughout the reform process, representatives of the Austrian informatics community, coordinated by *Informatik Austria*, engaged with the Ministry of Education, political parties, chambers of labor and commerce, trade unions, teacher organizations, and other stakeholders. Beyond contributing disciplinary expertise, they collected evidence and argued that informatics is part of general education and therefore needs a visible place in the curriculum.

Stakeholders did not share a common understanding of informatics. The arguments raised against a visible, standalone informatics subject fell into four recurring categories:

- **Understanding of the discipline.** Informatics concerns ICT use and digital application skills; it is not a scientific discipline.
- **Need for disciplinary visibility.** Informatics can be integrated with other subjects and does not require curricular space of its own.
- **AI as a substitute for informatics.** AI systems perform computational tasks, so students no longer need informatics.
- **Perceptions of the subject.** Informatics is difficult, boring, and unattractive, especially to girls.

We responded with five main arguments:

1. **General education.** Understanding and shaping a world organized through computational systems requires informatics concepts and methods [2]. This was our primary argument, because it derives the need for informatics from the purpose of school education itself.
2. **Autonomy and democratic agency (*Mündigkeit*).** Computational systems allocate credit, rank public debate, sort applicants, and support administrative decisions. They are not natural phenomena: they are designed and encode choices open to political contest. A democracy in which citizens cannot form a judgment about such systems cannot hold those choices to account and is left to defer to whoever built them.
3. **Participation.** Compulsory, early instruction reaches students who otherwise would not choose the subject.
4. **Digital sovereignty.** The systems that run public administration, health care, energy, and finance are largely built and operated elsewhere. A country that cannot build, audit, and maintain such systems cannot choose its

own terms of use and must accept those of its suppliers. That capacity rests on a supply of people who understand the technology, which in turn rests on school education. Sovereignty is therefore an educational question before it is a procurement question.

- 5. Skills and economic value.** A study by the *Austrian Economic Chamber* projects a shortfall of some 39 000 IT specialists by 2030 and an annual loss in value added of about seven billion euros.

The economic argument is often reached first. While effective with industry, it invites the objection that general schools educate for life, not jobs. Our response is that informatics is not primarily justified by labor-market demand; understanding the computational systems that shape everyday life is itself part of general education.

A second argument concerned gender and accessibility. We were told that informatics sounds forbidding, particularly to girls, and should therefore be folded into a broader subject, such as media education, so that they encounter it without noticing.

This argument assumes that the difficulty lies with the students and their gender. It withholds what enables students to act on their aptitude: knowing what they have learned and what it is called. A student who does not know she has done informatics cannot choose it, claim it, or build on it. Stereotypes are dismantled by teaching the subject early and visibly, not by removing it from the timetable.

Empirical evidence challenges the underlying assumption. In Germany, compulsory informatics is associated with smaller gender differences in competence and higher participation by girls in upper-secondary informatics [18]. A similar pattern is reported for socioeconomic background. International work on inclusive informatics education finds that participation depends on access to the subject [14], with Northern Ireland as an example [13]. Low participation is therefore not evidence of low interest; it may reflect the conditions under which girls encounter the subject. The remedy is better teaching and a visible subject, not concealment.

AI posed a communication problem. From a disciplinary perspective, AI has long been part of informatics and builds on its foundations. Its public visibility created expectations of a visible curricular response while also feeding the argument that AI reduces the need for informatics. We therefore had to communicate continuity and change at once: *the foundations remain, but their relevance and contexts of application are changing* [2].

A separate argument for integration concerned the proposed merger of informatics and media education itself. The two fields differ fundamentally in method: informatics formalizes, constructs, and tests artifacts, while media education interprets and criticizes texts and social practices. Neither is a special case of the

other. They differ in teacher training, and a merged subject may be taught by whoever is available, causing its content to drift towards the teacher's home discipline. Shared subject matter is not an argument for a shared subject: physics and ethics overlap, as do chemistry and environmental policy, yet no one proposes merging them. This was not a partnership of equals. The underlying conflation of informatics with computer use is illustrated by the position that computational thinking is a synonym for digital competency and a subfield of media competency [19].

The decisive opposition was not about informatics at all. Additional periods had to come from somewhere, and the ministry proposed reducing curricular space for Latin or other languages. The teachers' union objected vehemently, calling it an assault on the "Gymnasium." A petition against reductions in Latin received over 40 000 signatures, including three Austrian Nobel Prize winners. This created an unfortunate and inaccurate perception of informatics as an adversary of classical education.

Our response was not to argue against Latin. The case for Latin rests on sound educational grounds: structure, precision, and understanding of formal systems. Those grounds support informatics equally. In informatics, the formal system is also executable, so imprecision produces immediate and non-negotiable feedback, and students build systems instead of only analyzing inherited ones.

An important argument by the unions was university readiness, which we could answer directly. Informatics is among the largest fields of study, and computational methods are used across the natural sciences, engineering, economics, medicine, and increasingly the humanities. Students enter these programs without systematic preparation or a way to certify it. University readiness thus supports the inclusion of informatics in the final school-leaving examination.

Timetables are zero-sum, so a new subject creates opponents who have no quarrel with its content. The outcome, therefore, cannot be attributed to the strength of our arguments alone.

The process showed that sound arguments do not automatically make good policy arguments. Different concerns required different answers, and the order mattered. Disciplinary visibility cannot be assumed; it has to be argued for in terms the addressees already care about.

3 What "Informatics and AI" Means

Establishing a visible place for informatics was only one part of the challenge. The stakeholder debate also revealed different understandings of what informatics encompasses. The curriculum, therefore, had to answer a second question: what constitutes a broad and contemporary informatics education, and how should AI

fit within it? Rather than defining this scope from scratch, the Austrian curriculum builds on international reference frameworks and explicitly incorporates AI.

3.1 A Broad Informatics Foundation

The curriculum was deliberately designed as a broad informatics curriculum rather than one focused on programming, digital skills, or AI tools. It treats informatics as a scientific discipline with its own concepts, methods, and models, spanning theoretical, practical, technical, and applied informatics. Its disciplinary scope builds on the *Informatics Reference Framework for School* developed by the *Informatics for All* coalition [5]. Its eleven core topic areas provide an internationally developed reference for the breadth of school informatics, extending well beyond programming and digital technology use.

The Austrian curriculum complements these areas with *eight foundational concepts*: abstraction and modeling; data and information; algorithmization and automation; structuring and decomposition; formalization and language; systems and interactions; networking and communication; and uncertainty, data-driven modeling, and responsibility. They recur across topic areas at increasing levels of abstraction and differentiation in grades 9–11. Topic areas provide breadth, while foundational concepts support connections and cumulative progression.

This structure prioritizes systematic concepts and methods over specific software products. While technologies change, abstraction, representation, algorithms, modeling, and systems provide more enduring structures for understanding them.

3.2 Extending the Framework Towards AI

The international reference framework provided a broad disciplinary basis, but did not include AI as a core topic area [5]. The Austrian development group therefore complemented it with the UNESCO *AI Competency Framework for Students* [11] and its experience with school-based AI projects in Germany, linking AI competencies to informatics concepts and methods.

The curriculum introduces *Artificial Intelligence* as one of eleven central topic areas. To retain the reference framework's compact structure, its separate *Algorithms* and *Programming* areas were combined into *Algorithms and Data Structures, and Programming*. AI thus gains explicit curricular visibility without displacing another major area of informatics.

The AI competencies follow a deliberate progression rather than focusing on currently prominent tools. In the compulsory subject, students move from decision trees, classification, training, validation, and test data in grade 9 to supervised and unsupervised learning in grade 10. In grade 11, they examine neural networks and generative AI, compare AI approaches, and justify their suitability

Table 1: AI competency progression in Austrian informatics (ISCED 3).

Grade	Curriculum	Competency (Students can...)	Application Areas
9	Compulsory	Create, apply, and evaluate simple AI models using an algorithm and assess AI systems with regard to their suitability as well as ethical and inclusive aspects.	Decision trees; training, validation, and test data; classification.
10	Compulsory	Carry out basic machine-learning procedures step by step using appropriate algorithms and explain how they work.	Supervised learning (perceptron as a linear classifier); unsupervised learning (clustering algorithms).
	Elective	Model problems using facts and rules, implement them as a knowledge base, and derive solutions from it.	Knowledge-based systems.
11	Compulsory	Explain how neural networks and generative AI work, analyze their outputs, including errors and biases, and reflect on impacts on the world of work. They can compare AI applications and justify suitable approaches for given problem types.	Neural networks; forward propagation; generative AI; AI in the workplace.
	Elective	Implement selected machine-learning algorithms, apply them to data, and explain how they work.	Implementation of machine-learning methods; reinforcement learning.
12	Elective	Investigate the influence of training data and selected hyperparameters on learned models and compare supervised classification methods based on their decision boundaries.	Advanced supervised classification methods.

for different problems. The elective curriculum extends this progression towards implementation and deeper investigation, including knowledge-based systems, machine-learning algorithms, reinforcement learning, and the effects of training data and model parameters. The complete progression is shown in Table 1.

This visibility does not imply treating AI as a separate discipline. The curriculum defines AI as an integral field of informatics, with models and methods that build on foundational informatics principles. AI is therefore distinct enough

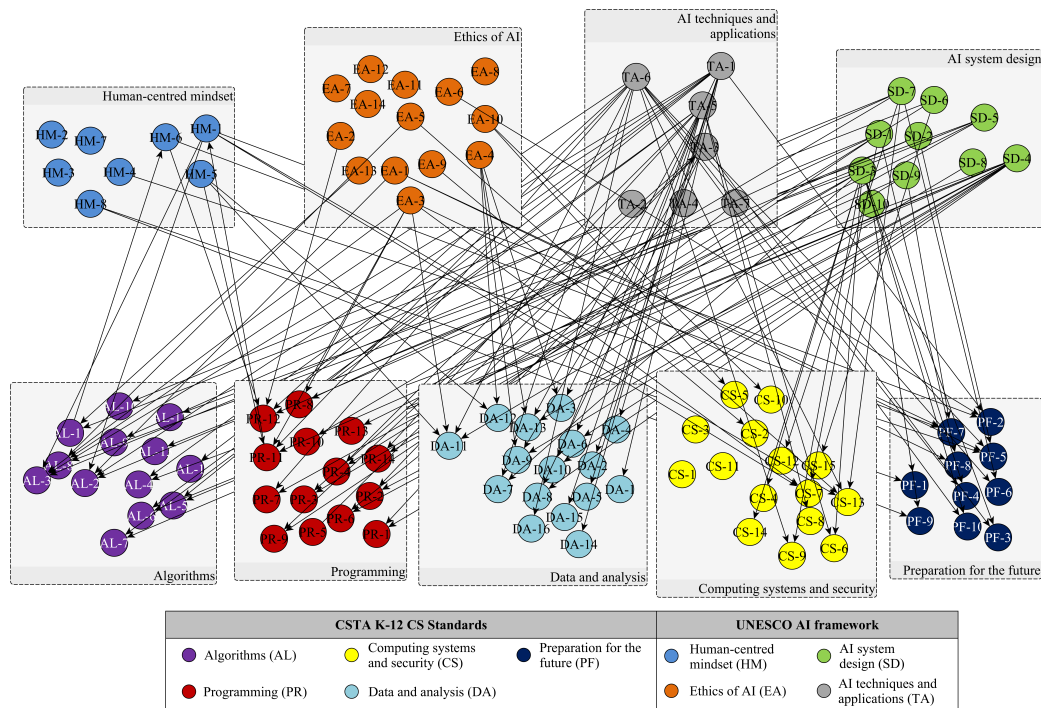


Figure 2: Dependencies between foundational informatics and AI competencies identified by Pasterk et al. [15].

to require explicit curricular visibility, but not independent enough to be taught without its informatics foundations.

The aim is not proficiency with a particular AI tool, but an understanding of different AI approaches that enables students to make informed choices about their suitability for particular problems.

3.3 AI as Part of Informatics

AI as an integral part of informatics is further supported by a systematic comparison of informatics and AI competency frameworks. Pasterk et al. compared the UNESCO *AI Competency Framework for Students* with the CSTA *Reimagining CS Pathways* framework and identified 130 direct dependencies, 127 connecting a foundational informatics competence to an AI competence [15]. Figure 2 shows that these dependencies span informatics areas including data analysis, algorithms, programming, modeling and abstraction, and computer systems.

These dependencies have a direct educational implication. Foundational informatics knowledge enables students to move beyond using AI systems to understanding and evaluating them. Concepts such as data representation, algorithms,

modeling, uncertainty, testing, and evaluation enable reasoning about their capabilities and limitations, and link societal and ethical questions (bias, fairness, transparency, and responsibility) to technical issues of data quality, model assumptions, algorithms, and system design.

AI also provides contemporary contexts for applying established informatics concepts: recommendation systems connect data, algorithms, and modeling; generative AI makes uncertainty and evaluation visible; and AI-generated programs raise questions of testing, debugging, and correctness. The curricular response is therefore neither to add AI tool use to an unchanged curriculum nor to replace informatics foundations with general AI literacy. AI becomes both an object of study and a context for applying foundational informatics concepts.

4 Conclusion

Austria's new subject "Informatics and AI" emerged from a contested process concerning both the curricular position of informatics and the educational response to AI. The resulting curriculum combines broad and enduring informatics foundations with explicit visibility for AI. Three lessons may be relevant for countries in which similar debates are only beginning.

4.1 Lessons Learned

Make informatics visible, and learn to advocate for it. European comparative evidence shows that the curricular form, continuity, and instructional time of informatics education matter [3]. The Austrian experience nevertheless showed that evidence alone does not make an effective policy argument. Disciplinary visibility cannot be taken for granted; it has to be argued for.

Curricular reform also negotiates scarce instructional time. Strengthening informatics may require reallocating lessons from established subjects, turning disciplinary arguments into concrete negotiations over the timetable.

Effective advocacy therefore required communication beyond academic discourse. Arguments were condensed into simple cards, supported by concrete examples, and adapted to stakeholders, emphasizing educational opportunities, economic consequences, girls' participation, technological dependence, or the ability to understand and shape computational systems. This addressed not only evidence, but also concerns, aspirations, and perceived risks.

It also required persistence: stakeholders were approached repeatedly to establish a shared understanding of informatics. For researchers and informatics experts, this may require unfamiliar engagement: scientifically sound arguments

must remain the foundation while becoming concrete, memorable, and relevant to educational decision-makers.

Use AI to strengthen informatics foundations, not to replace them. The rapid development of AI can itself provide an argument for informatics education. The educational choice is not merely whether students should use AI systems, but whether they should also understand, evaluate, and eventually help shape them. Contemporary AI illustrates this need: outputs require evaluation, errors need to be detected, and capabilities and limitations cannot be understood from application skills alone.

The Austrian curriculum, therefore, treats AI as both an object of study and a contemporary context for established informatics concepts. This shifts the focus from particular AI tools towards the knowledge needed to understand, evaluate, and shape computational systems. AI thus provides a reason to reinforce and extend informatics foundations rather than replace them.

Build interdisciplinarity on disciplinary foundations and capacity. Digitalization and AI raise questions that extend beyond informatics and benefit from perspectives from media education, civic education, mathematics, economics, and other disciplines. Interdisciplinary learning is valuable, but presupposes disciplinary foundations. Students need concepts, methods, and sufficient curricular time before they can meaningfully connect them across disciplines.

The same applies to implementation. Interdisciplinary approaches depend on teachers with the necessary disciplinary expertise. Where this is not available, substantial teacher education and professional development are required. Otherwise, the depth and emphasis of integrative instruction may depend too strongly on individual teacher backgrounds. Interdisciplinarity should therefore build on disciplinary competence, not substitute for it.

4.2 A Final Remark

Austria should not be understood as a blueprint for other educational systems. Important gaps also remain: lower-secondary education still does not provide a standalone informatics subject, and informatics is not an independent subject in the final school-leaving examination. Curriculum reforms depend on national school structures, institutional responsibilities, instructional time, teacher education, and political priorities. The Austrian experience nevertheless suggests a broader strategy: establish what informatics contributes to general education, communicate this in terms that different stakeholders can relate to, and respond to AI by making both the technology and its underlying informatics foundations visible. Indeed, the rise of AI does not reduce the need for foundational informatics education; it makes that need more visible.

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