heinnovate

Comparative case: Delft University of Technology (NL), Czech Technical University (CZ), University of Tartu (EE)

Delft University of Technology (TU Delft), Czech Technical University (CTU), University of Tartu (UT)

Abstract

This comparative case study examines how Delft University of Technology (Netherlands), Czech Technical University (Czechia), and the University of Tartu (Estonia) are integrating artificial intelligence (AI) into teaching, learning, and research. Each institution has developed AI-specific programmes, research centres, and staff training to build competencies and foster innovation. The initiatives have led to stronger interdisciplinary collaboration, growing student interest, successful spin-offs, and evolving teaching practices. Challenges include cultural resistance, regulatory hurdles, and keeping pace with rapid AI developments. Key lessons underline the importance of leadership support, flexible structures, and peer learning to successfully integrate AI in higher education.

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Institutional Profiles

Delft University of Technology (TU Delft)

Delft University of Technology (TU Delft) is a medium-sized university of technology of about 25,000 students, eight faculties, 16 bachelor's programmes and over 30 master's programmes.[1] The university's vision is to address complex societal challenges via their education of engineers who use innovative and entrepreneurial skills to push the boundaries of the technical sciences.[2] As a university of technology, a key part of TU Delft's institutional strategy is prioritising the development of technology-based innovations, including AI, to address societal challenges. The university readies graduates to enter the work force as highly prepared engineers who are equipped with the skills to do this, thus facilitating a strong connection between the education and research components at the university.

Activities

TU Delft works toward the integration of AI into learning content for students and teaching practices for teachers. Their Taskforce for Education AI, Data & Digitalisation[3] strives to make AI a part of the individual education for each student at TU Delft, no matter the field of study they are enrolled in. The university has launched a minor programme for students from any faculty to take part in, which covers AI usage methods and capabilities, as well as the importance of working with AI responsibly and recognising bias within algorithms. The minor has received an outpouring of interest, with the number of interested students exceeding the number of placements available. The programme coordinator plans to expand the number of students who can take part in the minor every year.[4] The minor programme concludes with the Capstone requirement, which tasks students with the job of designing an algorithm to address a social problem. The university has also newly established a master's programme in Data Science and AI Technologies, the first cohort of which is due to begin their course in September. TU Delft offers online courses in AI for non-university students as well.

The TU Delft in AI and Education (AIED) programme[5] focuses on the harnessing AI for the purposes of innovation in teaching—for example, implementing tools which utilise AI to make the assessment process easier for large classes. The AI Teachers' Programme also attempts to support teachers in developing their abilities to educate using AI in whatever

[1] About TU Delft, TU Delft: https://www.tudelft.nl/en/about-tu-delft

[2] Strategic Agenda TU Delft 2024-2030, Delft University of Technology, March 2024: https://filelist.tudelft.nl/TUDelft/Over_TU_Delft/Strategie/Institutional%20plan%20TU%20Delft%20-%20EN-DEF-online.pdf

[3] All TU Delft students to be educated in AI, TU Delft: https://www.tudelft.nl/en/innovatie-impact/home-of-innovation/special/all-tu-delft-students-to-be-educated-in-ai

[4] AI for all students at TU Delft, TU Delft: https://www.tudelft.nl/en/stories/articles/ai-for-all-students-at-tu-delft

[5] All TU Delft students to be educated in AI, TU Delft: https://www.tudelft.nl/en/innovatie-impact/home-of-innovation/special/all-tu-delft-students-to-be-educated-in-ai

subject matter they teach. The programme gives them a space to exchange experiences and knowledge about integrating AI into coursework and curriculum.[6] The AI Initiative's education working group also develops AI educational materials for teachers to use, keeping with TU Delft's value of creating open educational resources in collaboration with other educational institutions.

AIED has also built a small community of educators who teach in the field of machine learning specifically, which has been well-received at the university: teachers have the opportunity to reflect on effective and less effective approaches to teaching and curriculum. The goal is to eventually scale this group to a nation-wide level.

TU Delft also hosts 24 AI labs[7] focused on education, research, and innovation in AI and digitalisation. Examples include AI for Sustainable Water Management, Human-AI Collaboration in Design for Social Good, and AI as Deliberative Multimodal Systems. In keeping with TU Delft's theme of applying AI in cross-collaboration across different faculties, the labs aim to advance AI impact in applied sciences, design, and societal improvement.

Czech Technical University (CTU)

Czech Technical University (CTU) is one of the oldest technical universities in the world, with over 17,000 students,[8] over 3,000 academics and scientists,[9] eight faculties,[10] six university institutes[11] and 238 study programmes.[12] Research is carried out at all eight faculties and several university institutes, where the goal is to continue and strengthen CTU's reputation as an esteemed university with a focus on quality science and research, in order to create a space for it in the European research and education sphere.[13]

Activities

CTU's Artificial Intelligence Center (AIC)[14] was founded in 2001 and is one of the research units in the Department of Computer Science, which is based in the Faculty of Electrical Engineering. At the time of its inception, the AIC specialised in AI cybersecurity. Since then, it has expanded to cover a variety of AI-related research topics and applications, funded by national, EU, and American funding agencies, as well as industrial partner resources. The

[6] AI Educational Innovation, TU Delft: https://www.tudelft.nl/en/ai/education/ai-educational-innovation

[7] TU Delft AI Labs & Talent Programme, TU Delft: https://www.tudelft.nl/en/ai/tu-delft-ai-labs

[8] Data and Facts, Czech Technical University in Prague: https://www.cvut.cz/en/data-and-facts

[9] Data and Facts, Czech Technical University in Prague: https://www.cvut.cz/en/data-and-facts

[10] Faculties, Institutes and Other Parts, Czech Technical University in Prague: https://www.cvut.cz/en/faculties-institutes-and-other-parts

[11] Faculties, Institutes and Other Parts, Czech Technical University in Prague: https://www.cvut.cz/en/faculties-institutes-and-other-parts

[12] Data and facts as a mirror of CTU in Prague, Czech Technical University in Prague: https://results.cvut.cz/cvut-v-cislech

[13] Science and Research at CTU, Czech Technical University in Prague: https://www.cvut.cz/en/science-and-research-at-ctu

[14] Artificial Intelligence Center FEE CTU, AI Center FEE CTU: https://www.aic.fel.cvut.cz/about

AIC works on a number of national and EU-based research projects on various AI topics. Over 70 researchers work at the AIC, who work on over 30 projects. Research areas at the AIC include game theory, robotics, automated planning, machine learning, optimization, cybersecurity, and smart mobility. The AIC's overall focus is on tackling technological and scientific issues which will pose challenges in the future and studying AI in the context of its real-world implications on society.

The AIC is home to the Computational Robotics Laboratory (ComRob), which conducts research in the field of AI and autonomous robotic systems to address real-world issues, using computational approaches. The AIC also hosts the Stratosphere Library, a cybersecurity group which studies the intersection between cybersecurity and machine learning with a social focus on protecting citizens from targeted digital threats.

CTU is also part of the Prg.ai initiative[15], a start-up umbrella organisation for businesses, universities, and other organisations interested in AI research and application to build Prague as a hub and leader in the field of AI. The organisation was created in 2019 by academics from the Czech Technical University, Charles University, and the Czech Academy of Sciences, with contribution from the City of Prague. Prg.ai works to a) implement AI in at various levels of education to train future generations to use AI, b) build networks between academia and industry in Prague, developing new funding strands for research, and c) spread Czech successes in the field of AI internationally. Prg.ai coordinates communication across universities in Prague, promotes research, and organises events for the public to attend.

CTU also offers a specialisation in artificial intelligence[16] within the Faculty of Electrical Engineering's Open Informatics bachelor's and master's programme, training students in the ability to design and apply AI, assess if algorithms can meet their proposed needs, and apply machine learning models for data analysis. The programme combines a theoretical and practical approach and includes training in the most basic but also most important programming languages. Each year, hundreds of students enrol in the programme.

CTU is also developing a three semester-long master's programme (a variation from the typical four semester-long master's programmes in Czechia) in partnership with Charles University with the help of Prg.ai. The programme is going through the accreditation process at the moment, and the first cohort of students will be welcomed once this process is completed. The programme will have set course requirements, and course content will include computer vision, deep learning, natural language processing, large language models, and foundational machine learning, inspired by the current expertise in AI at CTU and Charles University.

[15] About Us, PRG.AI: https://prg.ai/en/about-us/

[16] Master Specialization: Artificial Intelligence, Faculty of Electrical Engineering CTU in Prague: https://oi.fel.cvut.cz/en/master-specialization-artificial-intelligence

University of Tartu (UT)

The University of Tartu (UT) is the leading research university in Estonia.[17] It is Estonia's largest and oldest university, with 14,000 students, 3,500 employees, 32 institutes, and four faculties (the Faculty of Arts and Humanities, the Faculty of Social Sciences, the Faculty of Medicine, and the Faculty of Science and Technology).[18] The university's internationalism and its high-quality teaching and research contribute to its reputation as one of the world's best universities.[19]

Activities

UT hosts an AI in teaching working group of about fifteen people.[20] The idea for the working group began in 2023 when a group of researchers and attorneys at the university began designing guidelines for AI in teaching and learning at UT in response to an ever-growing prevalence of AI. In 2024, the various groups across the university faculties who were already working on adapting to AI in teaching were unified and the working group was created. The working group operates on the basis that all four faculties should have an equal voice. In addition, the group has focused on fostering continuous collaboration with staff members who are eager to share knowledge about AI in teaching-related matters across the university's various structural units.

The working group intends to integrate AI into teaching at UT in a meaningful, conscious, and ethical way. Working group activities include a) joining the effort to amend university guidelines for using AI in teaching, learning, and thesis-writing,[21] addressing any questions that arise as advancements in AI are made, b) providing support and learning materials[22] on how to integrate AI in teaching meaningfully c) offering training sessions and events[23] for teachers to better understand how to integrate AI into their teaching. Some events entail staff members coming together and sharing their experiences using AI in teaching. Other trainings involve inviting specialists in AI in teaching to give a lecture or workshop about the best opportunities to integrate AI in teaching. To support these efforts, the group collaborates with higher education institutions in Estonia and internationally, welcoming speakers from abroad and sending staff to other events abroad to bring knowledge back to UT. The events and learning materials are designed to benefit both staff members and students.

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[17] University in brief, University of Tartu: https://ut.ee/en/content/university-numbers

[18] University in brief, University of Tartu: https://ut.ee/en/content/university-numbers

[19] University in brief, University of Tartu: https://ut.ee/en/content/university-numbers

[20] TÜ tekstirobotite töörühm, Tartu Ülikooli e-õppe ajakiri, Tartu Ulikool: https://etu.ut.ee/2024/tu-tekstirobotite-tooruhm/

[21] University of Tartu guidelines for using AI applications for teaching and studies, University of Tartu: https://ut.ee/en/node/151731

[22] Õppimine ja õpetamine tehisintellekti ajastul: kuidas kasutada tekstiroboteid õppetöös, University of Tartu: https://sisu.ut.ee/ti/

[23] Inspiration week on AI in higher education, Institute of Foreign Languages and Cultures, University of Tartu: https://maailmakeeled.ut.ee/en/content/inspiration-week-ai-higher-education

The working group also facilitates a blog site[24] about AI-related materials within UT's e-learning journal. It is open to any members of the university who have ideas for useful knowledge or resources to share for learning materials.

By the end of 2024, the working group initiated the development of a strategic action plan for the integration of AI usage at the university. While the focus of AI the working group has been on AI applications in teaching, the action plan also clearly highlights needs related to research and support services. The goal of the action plan is to agree not only on directions of action but also on responsibilities, resources, and key performance indicators. Currently, the action plan focuses on five directions: a) developing AI competencies among university members, b) accessibility and use of AI tools, c) adapting course content, teaching methods, and assessment practices, d) integrating AI into research, and e) enhancing support services through AI.

The university also offers nine AI courses across the Institute of Computer Science, the Faculty of Law, and the Institute of Education.

On the research side, UT led the establishment of the Estonian Centre of Excellence in Artificial Intelligence (EXAI) in 2024.[25] EXAI unites 13 research groups from three institutions in Tartu and Tallinn to conduct collaborative research on both foundational and applied AI. Its mission is to create methods for building trustworthy AI systems and to ensure these serve the best interests of society. EXAI focuses on four topics in the foundations of AI: adapting foundation models, implementing safeguards and trust, ensuring privacy and security, and developing hybrid AI systems. These research areas are particularly crucial for Estonia, given the country's pioneering e-government infrastructure, which takes a digital approach to ensuring a transparent and effective government.[26] The centre includes three language technology research groups dedicated to supporting the Estonian language, which is spoken by just one million people. The centre has three groups working in language technology to support the Estonian language, which has only one million speakers. EXAI also focuses on five application domains: e-governance, education, healthcare, business processes, and cybersecurity. These domains were chosen to leverage the expertise of existing research groups and to align with the Estonian Research and Development, Innovation, and Entrepreneurship Strategy 2021–2035.

Key indicators

- Knowledge Transfer: All three institutions show active engagement through research centres, labs, collaborations with industry and startups (e.g., TU Delft's AI labs and start-ups at CTU's AI Center)

[24] Tartu Ülikooli e-õppe ajakiri, Tartu Ulikool: https://etu.ut.ee/ai/

[25] Estonian Centre of Excellence in AI: https://exai.ee/

[26] E-Governance, E-Estonia: https://e-estonia.com/solutions/e-governance/e-services-registries/

- Regional Engagement: CTU's participation in Prg.ai to build Prague as an AI hub, TU Delft's focus on societal challenges, UT's AI working group engaging multiple faculties
- International Orientation: TU Delft and UT both emphasize international collaboration and reputation; CTU collaborates internationally through projects and partners

Introduction and Rationale

Defining the Problem and Urgency

The rapid advancement and widespread adoption of Artificial Intelligence (AI) technologies present both significant opportunities and challenges for higher education institutions (HEIs). Universities face the urgent need to adapt teaching, learning, and research practices to leverage AI's potential while addressing concerns about academic integrity, ethics, and equity. At the same time, there is a growing demand from the labor market for graduates equipped with AI competencies, making it imperative for institutions to integrate AI meaningfully into curricula and research.

The University of Tartu (UT), along with the Technical University of Delft (TU Delft) and the Czech Technical University (CTU), recognized that without strategic and timely action, their educational quality could lag behind technological progress, and their students might graduate ill-prepared for AI-enhanced work environments. Moreover, skepticism and fear around AI—such as concerns about misuse in thesis writing or job displacement—required proactive institutional responses to foster informed, ethical, and responsible AI adoption.

Rationale

UT's initiative to embed AI in teaching and research emerged from the commitment of its senior leadership, including the rector and deans, who prioritized AI integration as essential for the university's future. The establishment of a dedicated AI in Teaching working group and the Estonian Centre of Excellence in Artificial Intelligence (EXAI) reflects a concerted effort to build AI competencies, support staff and students, and create interdisciplinary collaborations.

Similarly, TU Delft and CTU undertook parallel initiatives motivated by their strategic vision to maintain academic excellence and societal impact through AI-driven innovation. TU Delft's bottom-up, teacher-driven approach encourages innovative AI integration tailored to diverse disciplinary contexts, while CTU's partnerships with local government and regional institutions aim to bolster AI academic programmes aligned with societal needs.

Innovative Elements

The initiative's innovation lies in its comprehensive, multi-faceted approach combining:

- Cross-disciplinary collaboration across faculties and institutions.
- Continuous professional development and training for teaching staff.

- Development of AI-specific courses and degree programmes.
- Strategic action planning encompasses teaching, research, and support services.
- Active efforts to reduce fear and resistance towards AI through open dialogue and resources.
- Integration of AI research excellence with practical applications, particularly in language technology, e-governance, healthcare, and cybersecurity.
- Regional and international partnerships to enrich knowledge exchange and capacity-building.

This approach not only supports the technical adoption of AI but also addresses cultural, ethical, and pedagogical dimensions, ensuring that AI enhances rather than disrupts educational quality.

Initiative Description

Starting Point/Motivation

To address the growing role of AI in society and prepare students for future careers involving AI, each institution initiated targeted efforts in teaching, research, and institutional development.

Actions Taken

- TU Delft: Established minor and master's programmes in AI, developed 24 AI labs, created AI-focused teacher support programmes.
- CTU: Established the Artificial Intelligence Center (AIC), AI specialisations in degrees, and collaborated through the Prg.ai initiative.
- UT: Formed the AI in teaching working group, developed strategic action plans, hosted training and events, and co-founded the Estonian Centre of Excellence in AI.

Stakeholders Involved

- TU Delft: Taskforces, education directors, external university partners (Leiden University, Erasmus University), national coalition SURF
- CTU: Prg.ai, Charles University, City of Prague, international and domestic research agencies
- UT: Working group members from all faculties, Estonian HEIs, international experts

Resources Used

- National and EU funding, institutional support, dedicated teaching staff, and specialised AI centres.

Infrastructure or Tools

- TU Delft: AI labs, AI assessment tools, open educational materials
- CTU: AIC, ComRob, Stratosphere Library
- UT: Blog platform, AI teaching materials, e-learning journal, EXAI

Impact and Success Factors

Delft University of Technology (TU Delft)

On an **individual level**, AI integration has significantly enhanced student and teacher experience. Software engineering students increasingly use AI models to develop applications, while teachers adapt their teaching and assessment methods, supported by collaborative working groups that allow idea exchange and reflection.

On an **institutional level**, the university is undergoing major changes to its accreditation and assessment systems, driven by AI's ability to generate student-like content. This shift includes exploring ways to assess students' ability to use AI effectively. Additionally, generative AI enables faster development of personalised course content and learning materials.

Czech Technical University (CTU)

On an **institutional level**, the Artificial Intelligence Center (AIC) has expanded through partnerships with national and international grant agencies, corporations, governments, and universities, and has launched five startups. A key project, the Research Center for Informatics (RCI), concluded in 2023 and enabled collaboration between senior scientists and early-career researchers, leading to increased funding, new hires, and improved facilities. CTU also collaborates with Charles University through Prg.ai, resulting in a multidisciplinary AI minor combining technical and social science perspectives.

On an **individual level**, the aim is to educate a new generation of AI experts. Students benefit from the diverse offerings in AI-related bachelor's, master's, and minor programmes, with many gaining employments at the AIC. Feedback shows that students value the interdisciplinary nature of the Prg.ai minor.

University of Tartu (UT)

On an **institutional level**, the AI in Teaching Working Group is shaping a university-wide strategy to integrate AI into teaching and learning. Its goals include keeping education quality current, supporting staff and students in adopting AI, and addressing ethical concerns. The group emphasises that while AI can enhance education, over-reliance can hinder learning, advocating for balanced teaching methods.

On an **individual level**, the group aims to raise awareness and reduce fear around AI among faculty. Events and training sessions—attended by over 120 staff in the latest session—foster interest, discussion, and peer learning. Although some teachers remain sceptical, ongoing surveys and outreach help assess needs and guide improvements. A student-specific survey is also planned to refine AI usage guidelines in coursework.

Success Factors

One supporting mechanism for these institutions is **collaboration with external actors**. TU Delft is part of a regional knowledge coalition[27] for AI, data, and digitalisation with fellow Dutch universities Leiden University and Erasmus University Rotterdam. The coalition is working towards a large-scale regional education programme across South Holland. UT also collaborates with other institutions in Estonia: the university works with research groups from other institutions in Tartu and Tallinn to conduct **collaborative research** in AI at the Estonian Centre of Excellence in Artificial Intelligence. Working with fellow universities on a regional level provides opportunities for cross-collaboration and bigger-scale impact. In addition, CTU's collaboration with other institutions and the city of Prague in the Prg.ai initiative strengthens its ability to build AI-focused academic programmes and foster academic collaboration with local industry. CTU's successes in AI integration are greater and more publicised due to being part of this partnership.

Encouraging and positive university strategy and attitude towards AI also play a key role in successful AI integration across HEIs, though this looks slightly different among different universities. The strategy for integrating AI into educational tools and teaching methods at TU Delft is based on a bottom-up, teacher-driven approach. Instructors are given the opportunity to design innovative ways of incorporating AI into their curriculum and teaching, based on the context of their course. Study directors make the decision on whether these innovative methods are implemented in various fields of study. It has been determined that course context is important when implementing new approaches to innovation, which is why AI implementation in education practices varies across departments, rather than being centred in a university-wide policy. In Estonia, UT has also made the integration of AI in teaching a priority: top-level management, including the rector and deans, understand the need to make AI adaptation and integration a priority. At CTU, the attitude around AI research and teaching is largely positive, as CTU has a long tradition of significant research which has a long-term impact on society. AI research is the latest component of that. The university finds opportunities for its AI researchers to be part of external discussions featured in the media about AI.

The **growth, reach, and advancements in AI worldwide** are also a more general motivator for the integration of AI at HEIs. Learning more about AI is very topical, and there are many important open AI research problems. There is also a trend of recognising the importance of improving the labour market's skills in working with and developing AI, which provides justification and backing for new academic offerings at these HEIs in the field of AI. Faculty and staff at these HEIs who have been early adopters of innovative developments in education lead the way for this growth. Those who advocate for the fact that the growth of AI necessitates a change in assessment methods, increased research, and new course offerings set a precedent for others to follow this lead.

[27] Regional Collaboration in AI, Data & Digitalisation, TU Delft: https://www.tudelft.nl/en/ai/research-innovation/regional-collaboration

An **interdisciplinary approach to integrating AI** is an important tool across these HEIs. Researchers at AIC at CTU note that the unique situation of colleagues coming together from various backgrounds to tackle common problems works as a facilitator for the Center's success. AIC staff includes nuclear physicists, robotics researchers who have experience working with hardware, and researchers working on computer vision (for example, facial recognition). The teaching and advising of new PhD students also bolster staff talent, attracting young people from all over the world and from different backgrounds to come be a part of the work at the AIC. The AI in teaching work group at UT also benefits from cross-disciplinary approach-- they make sure to have at least two members from each Faculty included in the working group, and they also receive support from the IT department at UT. The IT department stays on top of new AI advancements and helps UT find ways to implement them in a protected and secure way. At TU Delft, their 24 AI Labs also involve cross-collaboration across different faculties for the purpose of advancement in applied sciences, design, and societal improvement.

Challenges and Mitigation

A key challenge that accompanies AI implementation at TU Delft is a kind of necessary culture shift towards appreciating a new kind of learning that incorporates AI. In fact, some staff at TU Delft feel that new culture may need to centre around the idea that the purpose of attending university goes beyond securing a passing grade and accreditation. This is because the current assessment systems can be circumvented by AI—students can produce AI-generated content for their assignments. There is a mix of attitudes among instructors at TU Delft, with some teachers embracing the innovative potential of incorporating AI into the academic experience without losing the key components of learning and curiosity. However, other teachers are unsure or even afraid about what AI could mean for their ability to assess students. They are also wary of the risks of integrating AI into education and the potential legal repercussions of misusing it. A culture shift is a lengthy process and therefore poses a challenge. To try to mitigate this, the AIED programme does facilitate a central structure at TU Delft that coordinates aspects like securing technology and organising risk management for AI implementation to make the process easier for teachers.

Other perceptions of AI also pose barriers to integrating it at TU Delft. For example, some have an attitude of stubbornness towards excessive change, a kind of perception that engineering and design without AI have functioned well for years. One way to face this challenge to underline the importance of human competency that is needed to work with AI, and the principle that AI is there to enhance human creativity, which is still required. Other instructors, particularly in less technical fields, lack the understanding of just what the capacities of AI are, tending to over or underestimate its abilities, which makes it difficult to understand the impact AI can have in education.

- One way to mitigate these barriers is to educate teachers on how a variety of machine learning models work and differ from one another—as well as, of course,

giving teachers access to these technologies so that they can experiment and become more familiar with them.

A similar wariness or resistance or change around AI also exists at UT and CTU. At CTU and in Czechia, there is somewhat of a social barrier to AI advancement: some people are quite conservative and are apprehensive at the thought of AI becoming more and more advanced. As misinformation spreads, some people become fearful of the unknown and what new developments AI will bring. Some teachers at UT do not trust the output of AI, or they are concerned about the ethics around it.

- The working group's policy discusses these concerns openly, encourage teachers to have dialogue about their concerns amongst themselves, and point teachers in the direction of materials and resources that will address their concerns. The strategy is a bottom-up approach which encourages teachers to find their own ways working with AI, inspired by others, rather than explicitly telling them what to do.

Further challenges to integrating AI in research, teaching, and learning at HEIs lie with institutional structures, legislation, and policy.

One of the challenges that the AIC at CTU faces is due to the way that research funding is set up in Czechia—most research project last about three years. There is an overall shortage in research funding, which leads to policymakers and research grant agencies choosing to finance short-term projects with broader objectives, rather than committing themselves to long-term opportunities. Furthermore, the AIC is classified as a standalone research unit within the CTU bylaws, meaning that it has no other duties beyond the research and teaching it carries out. It also has little regulation power—decisions to attend conferences, for example, fall to the department which oversees it, which can be limiting.

CTU legislation also poses some barriers for the purpose of establishing the new Prg.ai master's programme. The development has been lengthy due to bureaucratic processes putting the final confirmation on hold. This can be challenging, given that many stakeholders have invested significant time and effort into establishing the new programme, with no clear outcome as of yet.

An indirect challenge for the integration of AI in teaching at UT is the fact that teaching at the university is fairly autonomous. Teachers can make the decision about what teaching methods and angles to include their courses, so communicating with them over time is the best way to encourage change.

- AI is making rapid advancements, and forming long-term plans is challenging. Therefore, the challenge is to keep a slow-moving university up to date with the rapid changes in the field of AI advancement. This is why the working group's approach is to introduce staff to new learning materials, trainings, and events on the subject of AI in teaching over time.

Context

Regional collaborations are important contextual factors for advancing AI integration at these three HEIs. UT is a member of the European University Alliance and The Guild of European Research-Intensive Universities, and it has also held joint seminars with all Estonian public universities. These collaborations have revealed to UT that their fellow universities are also moving towards trying to adapt to AI in a changing world, and they are eager to welcome speakers from global universities to contribute to the AI conversation at UT.

The city of Prague plays a key role in the development of the Prg.ai initiative of which CTU is a part. At the time of Prg.ai's inception, the mayor of Prague was a member of the Czech Pirate Party, which is a liberal progressive political party in Czechia that is quite proactive about IT developments. Therefore, he was very supportive in the establishment of Prg.ai.

At TU Delft, the university has connections with national and international institutions, businesses, and local partners in Delft.[28] They are also working with fellow Dutch universities, Erasmus University Rotterdam and Leiden University, to improve education about AI for students.

The Netherlands also has a central organisation called SURF[29] for the knowledge sharing of all Dutch higher education institutions which is focused on digitalisation in higher education. One of their goals is to establish a national large language model. The national push for AI integration in higher education is also a motivator for universities like TU Delft to implement this on an institutional level.

In the Netherlands, accreditation requirements at the national level also play a part in the process: the capabilities that higher education instructors must prove they have in order to secure a teaching qualification in the Netherlands now include knowledge of innovative topics and the use of digital tools in teaching. This demonstrates a national commitment to ensuring that teachers are comfortable developing ways of integrating digital advancements like AI into their course content and teaching and should help further that mission at TU Delft and other Dutch universities.

Conclusions and outlook

A key motivator for integrating AI into teaching, learning and research is overall university support for this process. Two of the universities profiled in this case study are technical universities who have particular interest in producing research related to recent technical advancements like AI and building students' strengths in working with AI. All three

[28] Strategic Agenda TU Delft 2024-2030, Delft University of Technology, March 2024: https://filelist.tudelft.nl/TUDelft/Over_TU_Delft/Strategie/Institutional%20plan%20TU%20Delft%20-%20EN-DEF-online.pdf

[29] About SURF, SURF: https://www.surf.nl/en/about

universities enjoy a commitment from their senior management to boosting AI integration at these universities, and all universities have particular teams devoted to AI in integration in teaching, learning, and/or research. These advantages help them not only to develop ideas for new ways of integrating AI at their institutions, but to secure the necessary funding and human resources to establish these groups, centres, and events.

Collaborations across interdisciplinary faculties and with other regional actors strengthens universities' AI offerings in degree programmes, research, and outreach. TU Delft is part of a regional knowledge coalition for AI with several other universities in South Holland. CTU collaborates with several other universities in Prague as well as the city of Prague to set up new cross-institutional degree programmes related to AI, which involve a variety of subject areas across the institutions. UT invites experts from other Estonian universities to share their knowledge about AI in teaching, particularly in the context of the Estonian language. They also structure their AI in teaching working group around the requirement that two members from each Faculty at the university are included. All three universities are therefore harnessing their networks across fields of study and throughout their local regions, strengthening their outputs and progress towards integrating AI.

Educating AI-resistant teachers about the exact capabilities of AI and the importance of human interaction with AI is necessary, due to a general public hesitancy to make AI a part of higher education teaching and learning. Teachers at all three institutions show signs of wariness, stubbornness to change, and/or denial that AI will affect their particular subject of teaching. Part of this apprehension can be attributed to misinformation. Staff members' distrust in AI can be eased through exposure to and practice using AI technologies, education on the capabilities that AI does and does not have, and an emphasis on human capabilities that are needed to effectively utilise AI.

Sources and contacts

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