AI-Adapted Learning and Coursework in Distance Education with Online Learning Platforms

Andreas U. Schmidt*[a]

a) Wilhelm Büchner Hochschule, Hilpertstr. 31, 64295 Darmstadt
* andreas.schmidt@wb-fernstudium.de

Abstract

Generative AI fundamentally challenges traditional written coursework in distance education, rendering conventional containment strategies ineffective. This paper presents a pedagogical framework implemented in Master's-level cyber security modules at Wilhelm Büchner Hochschule that strategically addresses AI integration through platform-based design. Using the Milanote visual workspace, the approach combines autonomous task selection from emerging topics with minimal published sources, deliberately open-ended formulations requiring explicit audience decisions, mandatory dual-board architecture separating content from reflection, multi-modal composition requirements, and evaluation criteria emphasizing curation and didactic quality over reproduction. Rather than restricting AI use, the framework explicitly encourages reflective AI integration while structurally incentivizing critical engagement through multiple decision points that complicate unreflective adoption. This design demonstrates how thoughtful pedagogical architecture can transform AI from an assessment threat into a catalyst for developing higher-order cognitive competencies essential for contemporary professional practice, while maintaining the practical constraints of distance education.

Introduction: Learning and Teaching in the Age of AI

School teachers and university professors alike are deeply worried about the effects of unscrupulous use of AI[1] tools by students on learning experience and outcome[2,3]. As R. W. Gehl, Research Chair of Digital Governance for Social Justice at York University in Toronto put it:

“GenAI can simulate all of the [reflection] steps: it can summarize readings, pull out key concepts, draft text, and even generate ideas for discussion. But that would be like going to the gym and asking a robot to lift weights for you.”[4]

Though AI usage by students is already widespread and for many, AI has already become an integral tool in their studies[5], empirical research on the effects is yet scarce. One of the first studies to shed light on the effects of AI usage on students’ learning was recently performed at the University of Pennsylvania[6]. Firstly, its outcomes corroborate Gehl’s view: Students using GPT-4 directly to solve math problems were 48% more performant than a control group not using AI, but performed 17% worse than the same control group in an *ex post* exam without AI. But secondly, the authors showed that students using a pedagogically designed variant of AI – an *AI Tutor*, which does not give direct solutions but leads students through solution steps in a Socratic-styled dialogue – perform on par with the non-AI-users in the *ex post* exam[7]. On the other hand, it is now acknowledged that AI usage differs starkly between “strong” students who use AI proficiently to achieve remarkable results, and “weak” students who use easy to recognize cut-and-paste techniques with little didactical gain[8,9,10]. The technology, used without pedagogical care, tends to discriminate against the latter group and would widen this already wide social gap[11].

From a teachers' viewpoint, traditional examination formats, in particular in distance education, are challenged by students' AI usage. Especially, written term papers, i.e., short research reports on a pre-assigned subject with a given completion time, are of questionable value for the evaluation of students' qualification, given the availability of AI tools with advanced deep research functionalities[12]. Grading results which are obviously to large part generated by AI tends to frustrate teachers deeply[13].

The first major empirical study on the effects of AI usage specifically in the context of essay writing tasks was conducted by MIT researchers and collaborators from five universities[14] in 2024. The results seem alarming at first, indicating that students can *unlearn* intellectual skills when using AI in essay writing – they exhibited lower neural connectivity, mental engagement, and shallow outcomes when writing an essay without tool usage after having written three with LLM assistance before. The authors assert that learners may incur "cognitive debt" through unreflective, and too early, AI usage. However, the study design is very restrictive by imposing an arbitrary and uniform 20-minute time limit on the essay task. This arguably disadvantages AI tool users, as they constantly have to switch tasks between questioning the AI and working on the essay proper[15]. Apart from many research questions opened by this study, it clearly shows what kind of AI tool usage should be avoided.

Current AI technology also has intrinsic limitations and perils. Apart from the by now well-known potential for biased answers[16,17] recent research that answer quality can significantly degrade depending on small variations in tonality of a prompt or misspellings – LLM behaviour can be brittle[18]. Users tend to overestimate the capabilities of LLMs and put too much trust in answers[19], while it has become clear that even the heavily advertised "reasoning" models are a far cry from real reasoning and at best invoke "the illusion of thinking."[20]

Ultimately, after education follows labour. The major application field of AI assistants in the workplace is software coding[21]. The AI research institute METR has taken a closer look at the productivity of programmers assisted by AI and found surprisingly negative results[22]: *Experienced* programmers suffer up to 20% *decrease* in productivity when using common AI coding assistants, reportedly by frequently being required to correct code produced by AI. Yet again, this result can be turned around in favour of AI for *learning* programming. As anyone who tried it will confirm (and Linus Torvalds agrees to some extent[23]), AI is a great help for overcoming hurdles at the beginner stage or reaching the next, not yet mastered, level of programming skills. But using AI blindly as a coding tool cannot help understanding and learning as even AI tools themselves seem to agree[24].

We conclude: Whether AI has a positive or negative effect on learners in higher education depends on the careful planning of pertinent pedagogical strategies and guidance of students by educators. Fostering reflective and critical usage of AI is of prime importance and careful observation of its technological evolution is essential. But if used with care, AI can be a viable aide on students' learning paths, for example by lowering entry barriers (factual and psychological[25]), by fostering explorative learning, by providing a reflective counterpart on own thoughts, and so on. With all its limitations and caveats, AI in learning is here to stay.

Controlled Usage

Conventional methods to address AI usage by students in university education generally aim at controlling and containing the effects of AI usage and quickly reach their limits:

- It is by now consensus that **bans and rules to curb usage** of AI are bound to fail. Apart from questions of detectability[26] and provability, these approaches raise serious concerns regarding examination equality, especially in distance education.

- **Transparency rules** that control usage of AI by marking its contribution in coursework also run into the detectability issue.
- Automated **interactive examination**, as frequently used in the form of Web Based Trainings is already defeated by agent-based AI automation[27].
- **Mandating and marking AI usage** only helps as long as the technology has not become a ubiquitous cultural technology – which it will, eventually[28].
- **Raising examination criteria** is an emerging trend among academic teachers[29]. This may range from requirements to submit log files along with programming exercises to posing exam tasks that were created for later points of a curriculum[30].
- **Tutoring AI** has certainly great potential (see above and endnote 6). Retrieval-Augmented-Generation (RAG) agents fed with study material and acting as a chat tutor are only the beginning[31]. More evolved systems like Anthropic AI Tutor “Claude for education”[32] take the concept to the next level of Socratic teaching dialogs.
- **Specialised courses for AI competency[33]** seem to become ubiquitous as entry-level courses. While those may be useful to overcome basic usage barriers and to close knowledge gaps, I put a question mark behind this trend: Similar to the term “prompt engineering” – which has already almost fallen into obsolescence – such courses seem to assume a lot of knowledge that we simply do not and cannot have about the subject. The least and safe to say about this is that course contents will need frequent updates.

Problem Statement: AI and Coursework in Distance Education for Rapidly Evolving Topics

The problems described above are exacerbated in distance education, where student-teacher interaction is less frequent and regular. Radical solutions such as reverting examinations to oral formats and proctored exams only are neither practical or economical for distance universities, nor are they fostering equal chances among diverse student populations.

Here, we present an approach that respects the ancillary conditions of distance education, is light-weight in implementation, and adaptable to a wide range of situations. In particular we work under the guiding conditions that

1. AI usage is not explicitly treated or even mentioned in the module design (e.g., regulated via guidelines), since it is assumed to be an underlying cultural technique.

2. learning formats which break the common basic process of distance education – in particular additional, synchronous interactive elements are not used, in order to stay aligned with the institution’s processes.

In the case at hand, AI utilization is only the first factor guiding the solution design. The second important issue here, as we explain below in detail, is that the subject matter content of the course in question is rapidly evolving with many new technical aspects and interesting examples being published at least monthly. This constitutes another challenge for AI usage for coursework, as current LLMs have a cut-off date for their training data which limits their capabilities to treat novel subjects, despite operational features to search the Web and include newly found information in the generation context[34,35].

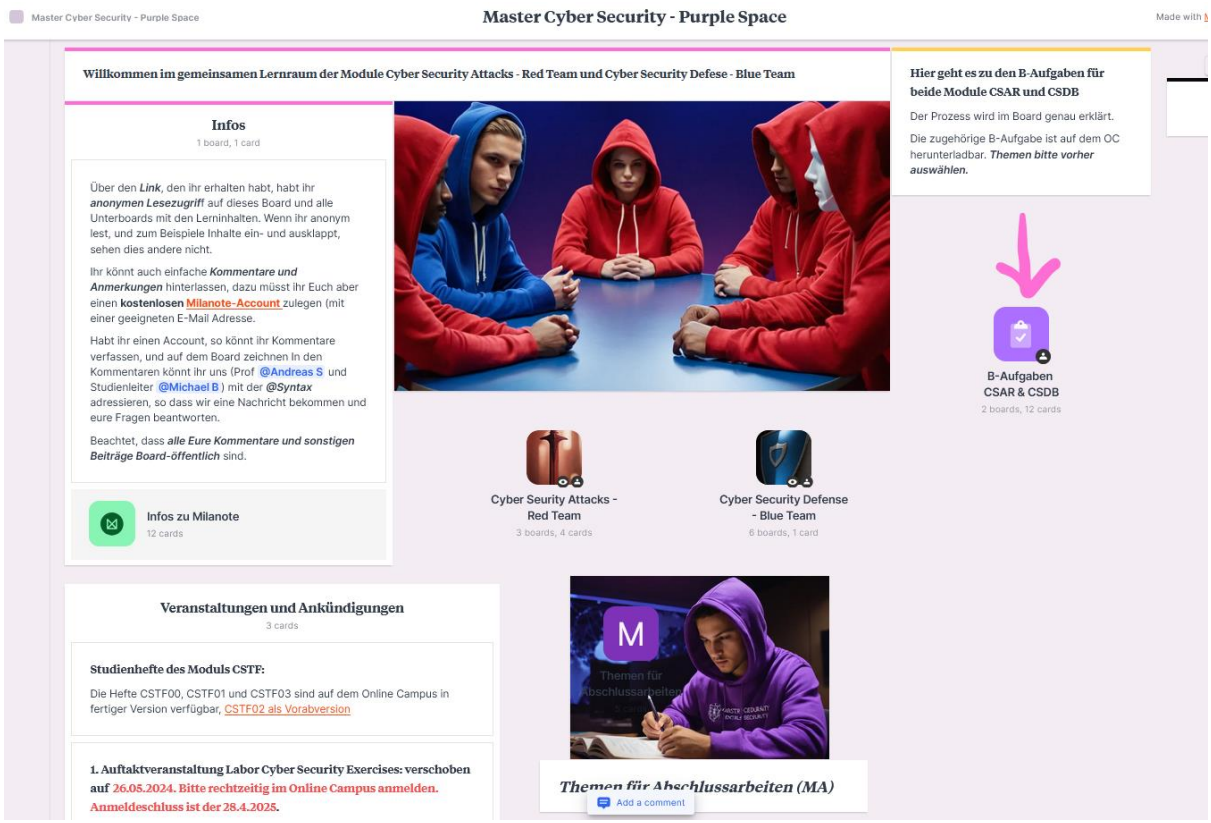

Fig. 1: Entry board of the learning space “Purple Space” of the two modules.

An Approach with Online Learning Platforms

The master course in Cyber Security at the Wilhelm Büchner Hochschule teaches a considerable share of current, rapidly evolving topics. Cutting edge information security technology and research, novel attack and defence methods, security incidents and their forensics, among other topics, are of high significance for the curriculum which aims to bring students to the forefront of science and technology in cyber security. The study directorate[36] concluded, that the lifecycle in which new relevant material emerges and older material becomes obsolete or at least necessitates updates, is 3 – 6 months.

The rapidly evolving topics are concentrated in two first-semester modules “Cyber Security Attacks – Red Team” and “Cyber Security Defense – Blue Team” with written coursework as graded exam performance. Standard study material – booklets – at the university incur a production cycle of minimally 6 – 12 months and standard update cycles of 12 – 24 months and similarly lower bounds for actuality hold for the tasks for written coursework, which, in turn, has a standard time allowed of 6 months. These timeframes are impractical and didactically not acceptable in view of the topicality of subjects.

We decided to use the online platform Milanote[37] for the embodiment, conveyance, and maintenance of the learning contents of the two modules. Fig. 1 shows the entry board with the boards containing the learning content at the centre and the Board “B-Aufgaben” leading to the coursework on the right.

The flexibility of Milanote boards fosters the usage of an extremely wide spectrum of presentation modes for didactic content, adapted to the various topics. Written content and exercises can be mixed and arranged together with links to external resources such as web sites, videos or papers. Fig. 2 shows an example with a rather traditional arrangement of content.

Fig. 2: Example content board.

The standard curriculum assumes that the course material is digested in 3 – 6 months. The arrangement of the boards makes it very clear that coursework is done in the same format of Milanote boards in which the course material is presented, so that the latter also serves as examples.

Students are led to the coursework through the coursework description board “B-Aufgaben” shown in Fig. 3. The main content of this board (on the left of Fig. 3) is a detailed, step-wise description of the coursework process including formalities, explanation of the topic choice procedure, content preparation guidelines, and explicit grading criteria. An example board (bottom right in Fig. 3) shows the formal structure of the coursework board.

The guidelines for preparation of the coursework by students and the criteria for evaluation and grading differ in some essential didactic points from traditional essay-writing or problem-solving tasks:

Open-Ended Task Design: The platform employs deliberately concise and open-ended task formulations to foster autonomous decision-making and creativity among students. A key feature of this approach is the freedom to determine the contribution format based on the intended target audience. Unless explicitly specified in the task description (e.g., "technical deep-dive"), students independently decide whether to create tutorials, scholarly analyses, security awareness materials, or alternative formats. Students must explicitly articulate their chosen format and rationale either in the contribution's title, an introductory section addressing the target audience, or within the reflection component

AI Integration: The pedagogical framework explicitly encourages the reflective use of AI tools for research, content development, and illustration. Students are invited to design interactive elements within their contributions that require readers to employ AI intelligently. However, this integration is predicated on critical evaluation and careful verification of AI-generated outputs. Students document their AI usage within the reflection board (see below), with detailed prompt-response documentation required *only* when particularly

significant insights emerge. This approach balances technological adoption with critical AI usage competency.

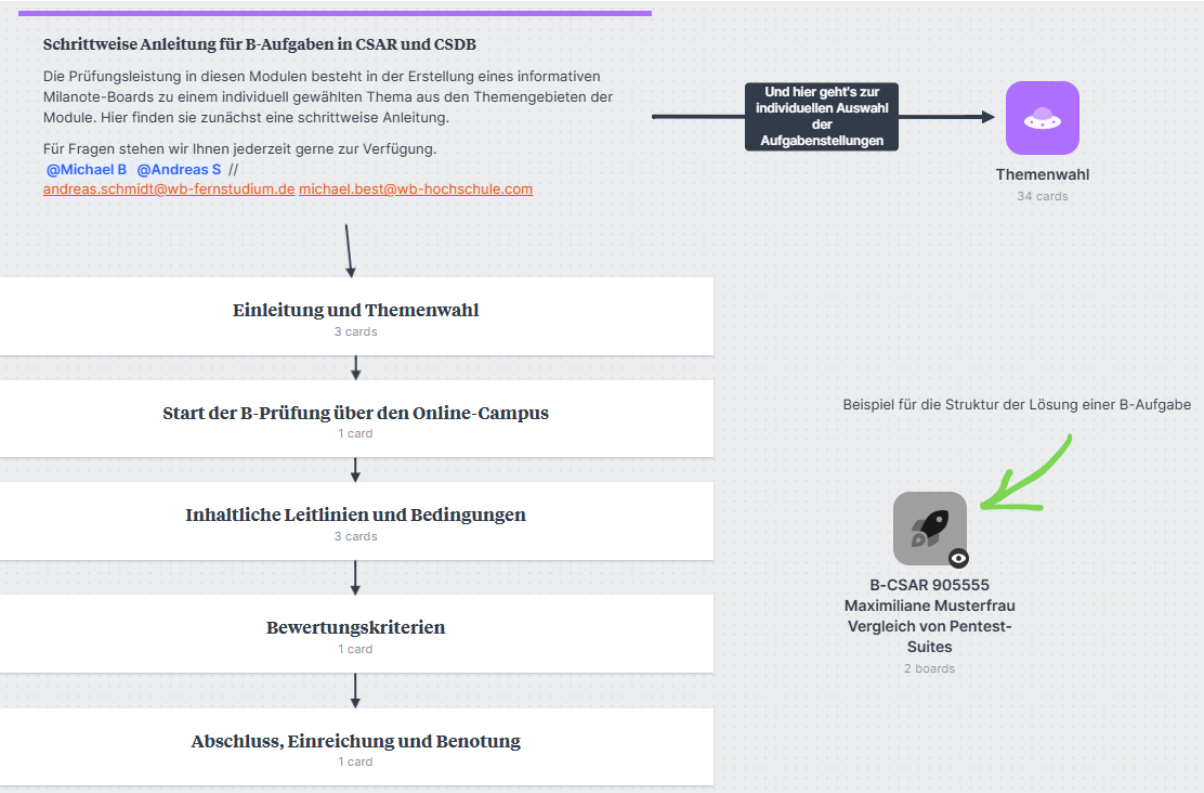

Fig. 3: Coursework description board.

Dual-Board Architecture: Content and Reflection Boards. The platform structures student work into two distinct components that fundamentally support reflective practice. The **content board** presents the substantive coursework solution in a multi-media format, with scope guidelines approximating 10-12 text pages or 1-2 hours of engaged reading time when accounting for embedded and linked media.

The **reflection board** serves as a transparent window into the student's intellectual process—functioning as the "notebook" underlying content composition. Students compile research materials, literature references, preliminary structures, and documentation of their selection and evaluation criteria. This workspace explicitly remains ungraded, positioning it as an authentic thinking space rather than a performative exercise. However, its presence is mandatory for assessment eligibility.

This architectural separation deliberately encourages metacognitive engagement: by requiring students to externalize and organize their decision-making processes separately from polished outputs, the platform transforms reflection from an abstract expectation into a concrete, integrated practice within the workflow itself.

Assessment Framework: Evaluation focuses exclusively on the content board and employs a 100-point rubric distributed across four criteria:

- **Conception** (10 points): Assesses the content structure's completeness (coverage of essential topics), appropriateness (exclusion of irrelevant material), and balanced weighting of components.
- **Self-Created Material** (40 points): Evaluates the quality of original textual and media contributions in relation to the task requirements.

- **Selection and Integration of External Resources** (30 points): Assesses the student's capacity to research, curate, and critically contextualize external materials within the contribution.
- **Didactic Quality** (20 points): Examines the pedagogical coherence of the contribution, including content sequencing, element interconnections, appropriate use of platform affordances, and overall design effectiveness.

This evaluation format fundamentally departs from conventional written coursework evaluation in several respects. First, it explicitly values curation and contextualization of existing knowledge alongside original production, recognizing contemporary information literacy as equally important to content generation. Second, the didactic quality criterion repositions students as knowledge mediators rather than mere demonstrators of understanding — they must consider audience, pedagogical flow, and communicative effectiveness. Finally, the conception criterion elevates structural decision-making and content architecture to explicit assessment dimensions, making typically implicit scholarly practices transparent and accountable.

Students are then led to the topic selection in the sub-board “Themenwahl,” part of which is shown in Fig. 4.

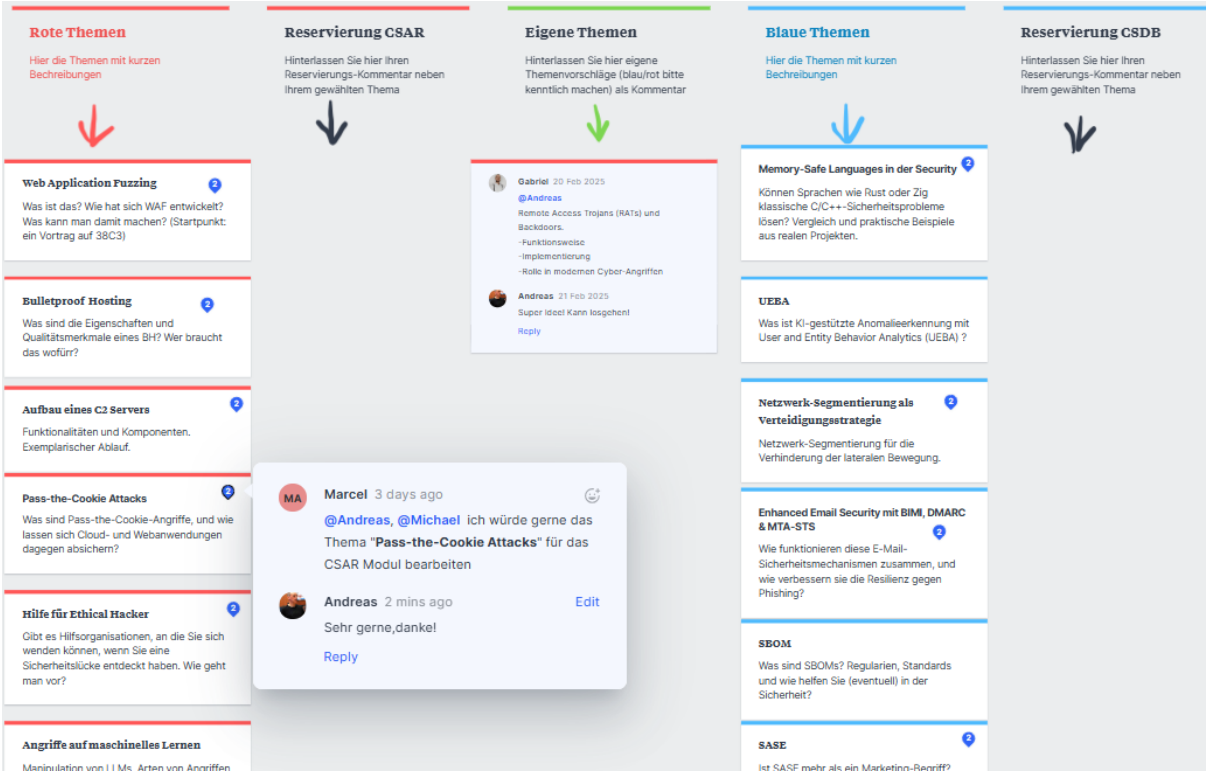

Fig. 4: Task selection board for coursework.

Students can pick a topic from one of the two columns shown, one for each of the two modules, or make their own suggestions in the middle (green) column. Topics are reserved individually by leaving a comment which is then acknowledged by a tutor on a first-come-first-serve basis, using the time-stamps on Milanote comments. It is important that, in relation to the main (and mainstream) learning content of the modules, the assignment topics and tasks represent niche subjects of cyber security such as specific security technology details, recent attacks and their techniques, or subjects of topical research papers. Another important feature is the possibility to make own topic suggestions (green

column in the middle of the board), which is done publicly to serve as inspiration for co-students.

Students then prepare their coursework autonomously on Milanote during the allowed time of 90 days. To conclude the assignment and start the grading process, they export a PDF from their board and submit it to the university's online campus in line with established procedures. The PDF – concurrently used for archival and quality control – contains a read-only link to the students' coursework boards with which tutors can view the coursework. Tutors then assess and grade the Milanote coursework, and finally archive it in a closed Milanote space. "Spent" coursework topics are also moved to the archive board. Milanote automatically keeps a timestamp of when the topic has been assigned. This allows to recycle the topic after a certain period, e.g., 12 months. Figure 5 shows a well-designed example coursework board.

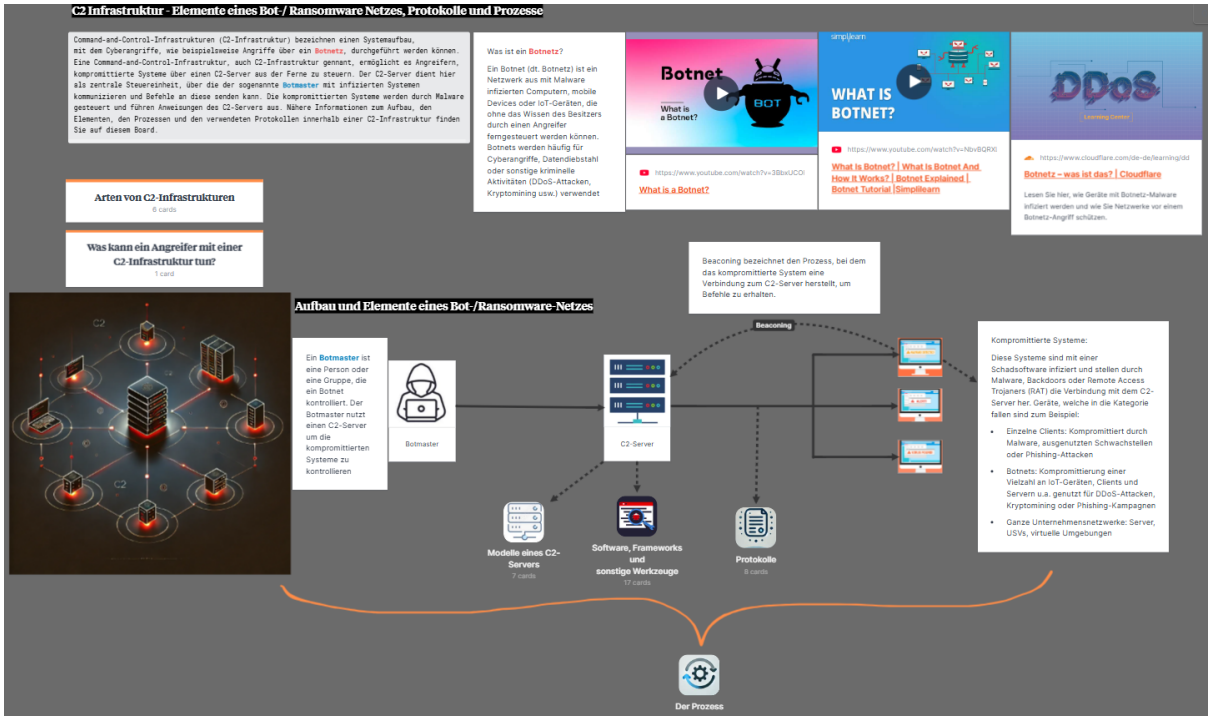

Fig. 5: Example of a Milanote coursework board (with various sub-boards) by a student on the topic of so-called command-and-control (C2) network infrastructures used by cyber criminals (Source: M. Meerheim, with friendly permission).

The diagram in Fig. 6 illustrates the three-phase digital learning workflow that demonstrates the integration between student coursework production and assessment processes in distance education. The workflow involves four key actors: the Student, Milanote (the digital content sharing and creation platform), the Online Campus (learning management system), and the Tutor. The interaction between them is designed with the principle of loose coupling in mind.

Study Phase: The process begins when the student accesses a study module through the Online Campus, which provides a link to course content. The student then utilizes Milanote to access and interact with the course materials and exercises, establishing the foundational knowledge base for subsequent coursework development.

Coursework Phase: The student retrieves coursework guidelines from Milanote and selects a specific topic for their term paper assignment. This topic selection triggers a notification to the tutor, who acknowledges the selection through Milanote, which subsequently notifies the

student of the approval. Following topic confirmation, the student registers their coursework assignment with the Online Campus, which formally issues the coursework assignment. The student then creates dedicated coursework boards within Milanote and develops their term paper using the platform's collaborative features.

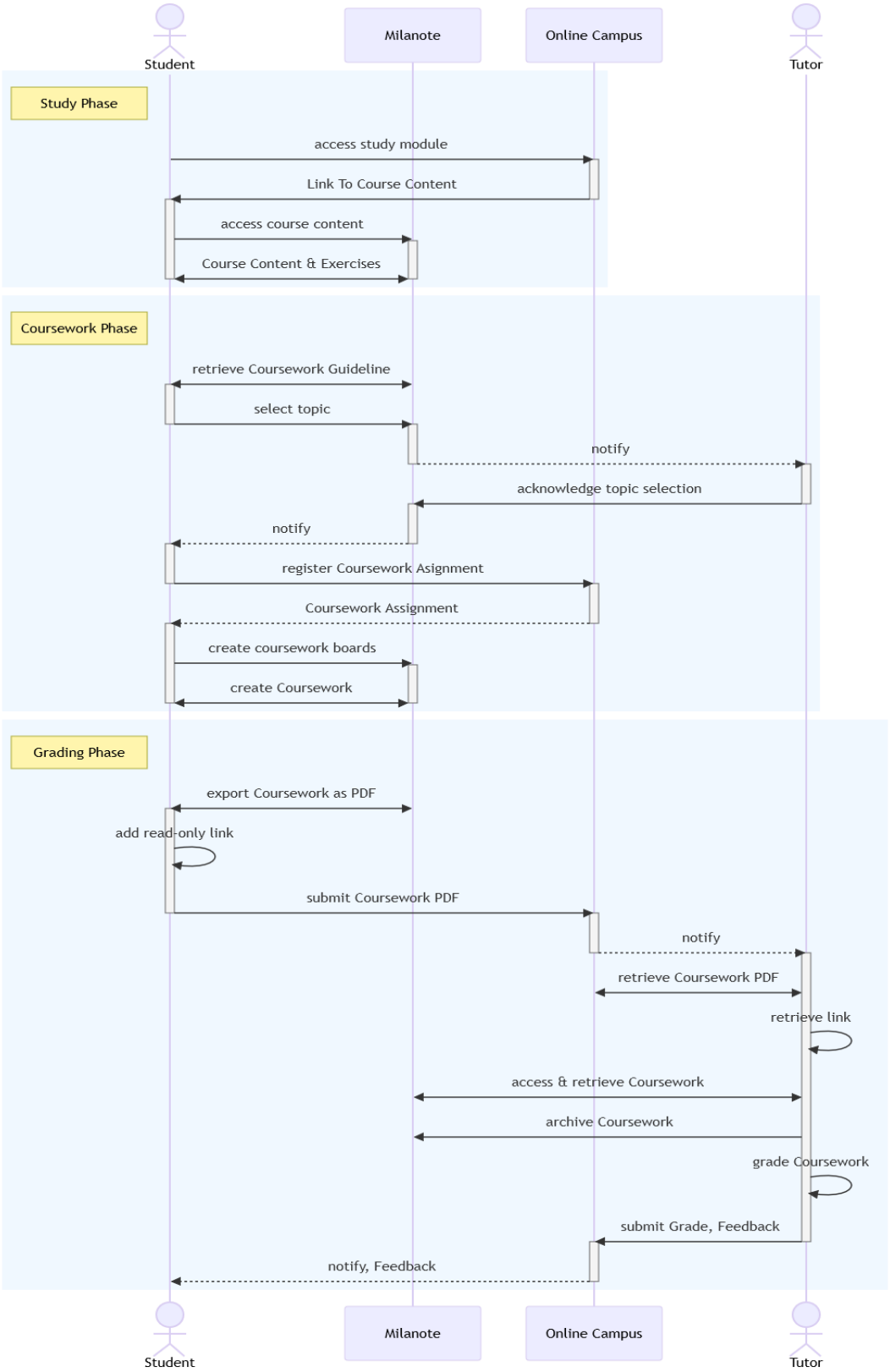

Fig. 6: Sequence diagram for online studies and coursework with Milanote.

Grading Phase: Upon completion, the student exports their coursework as a PDF document from Milanote, adds a read-only access link to the original Milanote content, and submits the PDF through the Online Campus. The system notifies the tutor of the submission, who then retrieves the coursework PDF from the Online Campus. Using the embedded link, the tutor accesses the original coursework content in Milanote for comprehensive review. After evaluation, the tutor archives the coursework in Milanote, completes the grading process, and submits the grade and feedback through the Online Campus, which subsequently notifies the student of the assessment outcome.

Pedagogical Characteristics of the Proposed Approach

The new learning platform and coursework process, by themselves, may not appear to be fundamentally better adapted to the usage of AI than other online learning courses. The arguments we present here to that end are rather based on a combination of more or less subtle details of the design. These are:

1. **Autonomous Task Selection and Open-Ended Design**: Individual task selection with the option for student-proposed subjects, combined with intentionally terse task descriptions, incentivizes students to conduct preliminary research and reflect critically on their preferences. The deliberately open formulation of tasks requires students to make explicit decisions regarding target audience and contribution format (e.g., security awareness materials for laypersons, tutorials, or technical deep-dives for expert audiences).

2. **Explicit AI Integration as Pedagogical Tool**: Rather than prohibiting or ignoring generative AI, the framework explicitly encourages its reflective use throughout the research, content development, and illustration processes. This approach acknowledges the technological reality students face while embedding critical evaluation as a fundamental requirement. By positioning AI as a legitimate tool that demands thoughtful application rather than a prohibited shortcut, the framework cultivates essential digital literacy competencies. Students must demonstrate not merely that they used AI, but that they employed it judiciously, evaluated outputs critically, and integrated results meaningfully—skills increasingly vital in contemporary professional and academic contexts.

3. **Reflection Board as Structural Metacognitive Requirement**: The mandatory reflection board transforms metacognition from an abstract expectation into a concrete, integrated practice. By requiring documentation of research processes, decision-making rationale, and material evaluation, the framework makes the intellectual journey transparent and accountable. This structural requirement fosters deeper engagement with subject matter independent of AI tool usage, as students must articulate and justify their methodological choices.

4. **Cognitively Demanding Assessment Criteria**: The evaluation rubric deliberately shifts focus from content reproduction toward higher-order cognitive skills. The clearly communicated weighted criteria—conception (adequacy of content and structure), original material, selection and integration of external resources, and didactic quality—reward critical engagement and penalize superficial, unreflective adoption of AI-generated content, regardless of whether AI tools were employed.

5. **Multi-Modal Composition as Cognitive Demand**: The intentional "media breach" inherent in using Milanote as the target platform and designing multi-modal tasks promotes profound subject matter engagement. The integration of diverse media formats (text, hyperlinks, images, videos) into coherent compositions requires students to adapt AI-generated content substantially and synthesize materials meaningfully. This multi-modal

requirement demands deeper conceptual understanding than purely text-based formats and significantly complicates unreflective adoption of AI outputs[38].

6. **Novelty-Driven Knowledge Challenge**: The selection of emerging or specialized topics with limited established literature and unpublished primary sources creates a strategic pedagogical advantage in the AI era. When addressing subjects on which generative AI models have limited or no training data—such as recent cybersecurity developments, novel protocols, or cutting-edge research—students cannot rely on AI-generated syntheses alone. This intentional focus on the knowledge frontier necessitates authentic research, critical evaluation of nascent sources, and original synthesis. Students must engage directly with preprints, conference proceedings, technical documentation, and expert discussions, developing the scholarly competencies required to navigate uncertain epistemic terrain where authoritative AI outputs are unavailable or unreliable.

7. **Feedback** is provided on each single coursework and is regularly given by the tutor to the student. Arguably, as far as evaluation of the AI utilization in the work is concerned, the tutor here takes part of the role of the “human in the loop” (HitL) in a safeguarded use of AI[39]. From this viewpoint, although the feedback is oriented on the evaluation criteria stated above, it also aims to improve the student’s own competencies to control the quality of AI generated content[40].

The platform's requirement for multiple and multidimensional interactions intentionally introduces complexity that necessitates reflective practice. This complexity mirrors the contemporary information environment students will navigate professionally, where knowledge work increasingly involves synthesizing heterogeneous sources, adapting content across media, and making strategic communication choices. A potential criticism suggests this merely adds arbitrary complexity to coursework. However, the complexity introduced is strategically focused on substantive content interaction and intellectual decision-making rather than procedural compliance. Significantly, the framework simultaneously reduces traditional formal requirements such as prescribed citation formats, font specifications, and standardized cover pages. This reallocation of cognitive demand shifts student attention from mechanical formatting compliance toward meaningful engagement with content structure, audience consideration, and knowledge curation — precisely the higher-order competencies that formal requirements often obscure or displace.

These subtle yet crucial design elements and choices, the implementation of which is only possible to in the context of a flexible content creation platform such as Milanote, aim to yield a large number of points during the preparation of coursework, at which students have to stop and reflect on topic, content, process, and – importantly – the recipients of their work. When AI is utilized, this incentive to reflection is actually reinforced, since goals must be turned into clear, goal-oriented prompts. Thus, we think that our approach spurs a proficient use of AI by its principles.

Discussion and Further Steps

I hope to have demonstrated that the lightweight approach of using an online content platform with a few pedagogical tweaks can be a basis to make progress regarding the stated problem of designing coursework in distance education under the assumption that AI tools are a ubiquitous cultural technique. Arguably, this is only a platform and the AI-directed pedagogical specifics described in the last section can only count as first steps. Yet, as a platform, the concept offers a lot of leeway for enhancements, and by this one may at least hope to be able to keep pace with future developments of AI, by gradual adaptation. We conclude this paper with a few examples of possible future additions, from close at hand to more ambitious:

- It is planned to include a “hall of fame” with outstanding coursework as a further motivation and best-practice examples.
- Another option considered is the inclusion of interactive online content (e.g., sandboxed code exercises) through plugin additions to the platform.
- Many content producers on the Internet already rely on AI tools to create multimedia tutorials. One will have to provision students with a well-curated toolset for this advanced creative task. Giving learners the possibility to explain their coursework in a multimedia presentation with a very low entry barrier would narrow the gap between asynchronous distance education and synchronous formats, without breaking the principles of the former.
- Of course, one would also like to leverage the “capacity augmentation” offered by AI, i.e., let students address task problems that they would not be able to attack in pre-AI coursework. We envision a system that guides students through incremental solution steps of a complex task, wherein baseline information for each step is given on the platform and students document progress there. A (set of) specifically designed AI tutor(s) may provide guidance through the process.

Finally, evaluation research will be of necessity, once the platform has generated enough student data. The accumulated coursework, in particular the reflection boards, can serve as a basis for that.

Progress will be reported.

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1. It would almost go without saying that by „AI“ we mean generative AI which mimics (at least) the intellectual output of human beings. Als at this point and for clarity, let us delineate the scope of this paper: We are solely concerned with AI in the context of teaching and learning in higher education. Nonetheless, we are aware that the products of higher education – engineers and scientists – will unavoidably be confronted with more grave consequences of higher developed AI. Advanced AI has already shown capabilities for autonomous production of truly novel scientific knowledge – albeit in yet limited contexts such as numerical fluid dynamics (J. Feng, R. Xu, X. Chu. “OpenFOAMGPT 2.0: End-to-end, trustworthy automation for computational fluid dynamics”. 2025. Available at arXiv. https://doi.org/10.48550/arXiv.2504.19338). Typical activities of highly educated people, such as performing bladder surgery, have already been demonstrated to be learnable and executable by AI-robotic systems (see J. W. Kim, J.-T. Chen, P. Hansen, *et al.* “SRT-H: A hierarchical framework for autonomous surgery via language-conditioned imitation learning”. *Science Robotics*, **10**(104), eadt5254, (2025). https://doi.org/10.1126/scirobotics.adt5254). The latter example is particularly striking since new, hierarchical, AI model architectures emerging there and in other advanced AI research points to the possibility of creating AI that exhibits all traits of consciousness. All the above and the big question “what then” are out of scope of the present paper.
2. J. Koebler, “Teachers Are Not OK*”. 404 Magazine*, (2025). Available at https://www.404media.co/teachers-are-not-ok-ai-chatgpt/.
3. S. Schröder, „‘Das ist kein Werkzeug!‘ – Meinungen zu KI in der Wisskomm“. (July 3, 2025). Available at https://www.wissenschaftskommunikation.de/das-ist-kein-werkzeug-meinungen-zu-ki-in-der-wisskomm-90403/
4. Cf. Koebler, (2025), op. cit., see Endnote 2.
5. According to a non-representative study, the usage rate has increased from 63% in 2023 to over 90% in 2025, see: J. v. Garrel, J. Mayer, „Künstliche Intelligenz im Studium - Eine quantitative Längsschnittstudie zur Nutzung KI-basierter Tools durch Studierende“. Hochschule Darmstadt, (2025). https://doi.org/10.48444/h_docs-pub-533
6. H. Bastani, O. Bastani, A. Sungu, H. Ge, Ö. Kabakcı and R. Mariman, Rei, “Generative AI Can Harm Learning”. *The Wharton School Research Paper*, (July 15, 2024). https://dx.doi.org/10.2139/ssrn.4895486.
7. This shows solid and obvious potential for usage of AI Tutors in distance and general online education.

8. H. Pham *et al.*, “How will AI Impact Racial Disparities in Education?“. *SLS Blogs*. Stanford Center for Racial Studies. Stanford Law School, (June 29, 2024). Available at https://law.stanford.edu/2024/06/29/how-will-ai-impact-racial-disparities-in-education/1.
9. T. Lai, C. Xie, M. Ruan and Z. Wang, “Influence of artificial intelligence in education on adolescents’ social adaptability: The mediatory role of social support“. *PLOS ONE*, **18**(3), e0283170, (2023). https://doi.org/10.1371/journal.pone.0283170.
10. T. Rasheed, A. Bashir, S. Hanif, and H. Gul, “Leveraging AI to mitigate educational inequality: Personalized learning resources, accessibility, and student outcomes”. *The Critical Review of Social Sciences Studies*, **3**(1), 2399–2412, (2025). https://doi.org/10.59075/j4959m50.
11. AI undoubtedly also has egalitarian potential. Right now, we are in the lucky situation that powerful AI is cheap enough to enable almost equal use. The consequences would be catastrophic if AI usage would be exclusive to the 1% and exclude the 99.
12. Phan, L., Gatti, A., et al. (2025). Humanity’s Last Exam. Available at arXiv:2501.14249. https://doi.org/10.48550/arXiv.2501.14249.
13. J. Koebler, op cit., see Endnote 2.
14. N. Kosmyna, E. Hauptmann, Y. T. Yuan and J. Situ, “Your Brain on ChatGPT: Accumulation of Cognitive Debt when Using an AI Assistant for Essay Writing Task”. (2025). Available at: https://arxiv.org/abs/2506.08872.
15. One should consider a general point here: Humans are cost-optimizing homeostats. When given an energetically costly task under time pressure, they would always minimize cognitive effort in favour of automation with tools – brain energy consumption is just too high in a stress situation. That is neither automobile’s nor AI’s “fault.”
16. I. O. Gallegos, R. A. Rossi, J. Barrow, M. M. Tanjim, S. Kim, F. Dernoncourt, T. Yu, R. Zhang and N. K. Ahmed, "Bias and Fairness in Large Language Models: A Survey". *Comput. Linguist.*, **50**, 1097-1179, (2024).
17. X. Bai, A. Wang, I. Sucholutsky, & T. L. Griffiths. “Explicitly unbiased large language models still form biased associations”. *Proc. Natl. Acad. Sci.,* **122**(8), e2416228122, (2025). https://doi.org/10.1073/pnas.2416228122.
18. A. Gourabathina, W. Gerych, E. Pan and M. Ghassemi, “The Medium is the Message: How Non-Clinical Information Shapes Clinical Decisions in LLMs”. *Proc. of the 2025 ACM Conference on Fairness, Accountability, and Transparency (FAccT '25)*, 1805–1828, (2025).
19. M. Steyvers, H. Tejeda, A. Kumar, C. Belem, S. Karny, X. Hu, L. W. Mayer and P. Smyth, "What large language models know and what people think they know". *Nat. Mach. Intell.*, **7**, 221–231, (2025).
20. P. Shojaee, I. Mirzadeh, K. Alizadeh, M. Horton, S. Bengio and M. Farajtabar, "The Illusion of Thinking: Understanding the Strengths and Limitations of Reasoning Models via the Lens of Problem Complexity". arXiv:2506.06941 [cs.AI], (2025). Available at: https://arxiv.org/abs/2506.06941.
21. Of course, the goal here is to get rid of the human programmer workforce entirely. It is not yet a good idea to let AI work unsupervised on professional coding jobs, though. The case of a Replit AI agent deleting the whole codebase of a software startup, see https://www.businessinsider.com/replit-ceo-apologizes-ai-coding-tool-delete-company-database-2025-7.
22. Becker, J., Rush, N., Barnes, E., & Rein, D. “Measuring the Impact of Early-2025 AI on Experienced Open-Source Developer Productivity”. (2025). Available at arXiv. https://doi.org/10.48550/arXiv.2507.09089.
23. In a recent conversation at the Open Source Summit Korea, Torvalds took a very measured position regarding use and no-use of AI in software development. While he advises against using AI at a large scale for production code, let alone the Linux kernel, he emphasizes, as we do here, that AI supported “vibe coding” lowers entry barriers for beginners. (watch at https://www.youtube.com/watch?v=tWx769t1JKg, and see also https://fosstopia.de/torvalds-ki-im-linux-kernel/).
24. A user of the popular AI coding tool Cursor got a response by the tool stating that “cannot generate code for you” and he should develop the logic himself with the “Reason: Generating code for others can lead to dependency and reduced learning opportunities.”, see https://forum.cursor.com/t/cursor-told-me-i-should-learn-coding-instead-of-asking-it-to-generate-it-limit-of-800-locs/61132.
25. Factual at least by providing unlimited and immediate access to a large body of knowledge, psychological by appearing as an impartial and benevolent counterpart.
26 Tools to detect plagiarism and AI usage are notoriously error-prone, cf. M. Perkins, J. Roe, B. H. Vu, D. Postma, D. Hickerson, J. McGaughran, H. Q. Khuat, „Simple techniques to bypass GenAI text detectors: implications for inclusive education“. *Int. J. of Educational Technology in Higher Education*, 21(1), 53 (2024). https://doi.org/10.1186/s41239-024-00487-w.
27. The YouTube channel c’t 3003 showed a tutorial on how to automate passing of web-based trainings (https://www.youtube.com/watch?v=YI5QsBWQQZI&t=190s), see also the opinion “The Great Online Learning Reset?” by Philippa Hardman (https://drphilippahardman.substack.com/p/the-great-online-learning-reset).

28. Then, marking proficiency of use of AI would be in the same category as marks on good handwriting.
29. This is, of course, a hint to the general fact that AI has the potential to raise the level of human intellectual activities as a whole.
30. M. Fries, S. L. Gössl, S. Hähnchen, M. Heidebach, C. Krönke, M. B. Strecker, T. Wischmeyer, M. Zwickel. “Juristisches Prüfen 2030”. *Verfassungsblog*, (Sept. 23, 2025). Available at https://verfassungsblog.de/juristisches-prufen-2030/
31. RAG chatbots are a good fit for distance eduction institutions which usually have a large stock of prepared educational material, often in PDF format, fo these systems to ingest. At Wilhelm Büchner Hochschule we use the own-developed (together with our sibling institution Euro-FH) and award-winning (see https://studienpreis.org/preistraeger/fernstudienprojekt-des-jahres-2024-ki-in-der-bildung/) tool KILEA with great success. First evaluations show that KILEA offers a low entry barrier for students to ask questions and relieves human tutors who gain time to care for students‘ more complex issues.
32. See https://www.anthropic.com/news/introducing-claude-for-education. In the meantime, OpenAI has introduced the „study mode“ for ChatGPT, that exactly follows the same approach.
33. See https://hochschulforumdigitalisierung.de/lernen-mit-ki/.
34. M. Sebők, R. Kiss “Understanding Knowledge Cut-offs in GenAI Models”. (Apr 5, 2025). Available at https://promptrevolution.poltextlab.com/understanding-knowledge-cut-offs-in-genai-models/.
35 J. Cheng, M. Marone, O. Weller, D. Lawrie, D. Khashabi, & B. Van Durme, “Dated data: Tracing knowledge cutoffs in large language models”. (2024). Available at: https://arxiv.org/abs/2403.12958v2.
36. The study director Michael Best and the present author.
37. Milanote (https://www.milanote.com/) is an Australian product with 35,000 customers worldwide, mostly SMEs in the creative sector such as design, as of 2024. It is a visual note-taking and project organization tool designed for creatives, allowing users to collect, arrange, and collaborate on ideas using flexible visual boards. Similar well-known tools include Miro, and Notion. A prominent academic user of Milanote is the MIT Media Lab (https://www.media.mit.edu/posts/designing-digital-workspaces-for-creativity-and-collaboration-in-online-project-based-courses/).
38. This point may well become moot in the future. It may be surpassed by progress in AI-based task automation techniques, or the integration of AI assistants into the Milanote platform itself, which is definitively a trend.
39. S. Kediyal, „The Critical Role of Human-in-the-Loop Approaches for AI System Success*“. Int. J. of Research in Computer Applications and Information Technology (IJRCAIT)*, **7**(2), 2579-2588, (2024).
40. Under our explicit assumption that AI is a cultural technique which has is here to stay, such competencies – spanning across various application fields – are of critical societal importance. Compare the mission statement of the project Human in the Loop: Autonomy and automation in socio-technical systems (HiLO) at the Humboldt Institut für Internet und Gesellschaft (https://www.hiig.de/en/project/human-in-the-loop/)