UNIVERSITÄT DES SAARLANDES

Human and Business Sciences
Educational Technology

Masterthesis

Exploring Students' and Teachers' Perspectives in AI-supported Classrooms

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for the Attainment of the Degree Master of Science (M.Sc.)

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Saarbrücken, September 2024

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Abstract

The increasing presence of AI-enhanced technologies in the classroom is changing the roles of both students and teachers, particularly in terms of student agency and autonomy. We conducted a speed-dating interview study with 16 secondary school students and 15 school teachers in Germany, to explore how student and teacher perceptions and preferences align or diverge. Presented with storyboards ranging from full learner control to full AI control, students and teachers had some common, shared views on how AI systems should be used and divergent preferences on how to use AI support in the classroom. The findings highlight the importance of the student-teacher relationship in shaping how both stakeholders prefer to use AI systems in the classroom. By bringing together the voices of students and teachers, we seek a more nuanced understanding of the balance between human agency and AI automation.

Keywords: Educational technology, Agency, Human-AI collaboration, Storyboards, Individual Learning

Acknowledgements

I would first like to thank my thesis advisors, Prof. Dr. Tomohiro Nagashima and Dr. Man Su, for their guidance, support, and insightful feedback throughout the process of this research. I am also deeply grateful to the students and teachers who participated in this study. Their willingness to share their perspectives and experiences was critical to the success of this work, and I could not have completed this research without their valuable contributions. In addition, I would like to acknowledge the generous support from JST, PRESTO Grant Number JPMJPR23I8, Japan. It was an honor to participate in the PULA+ project, which challenged me to grow as a researcher and provided me with a lot of knowledge and experience.

Finally, I would like to express my gratitude to my family and friends for their continuous support, encouragement, and understanding throughout my years of study and the process of researching and writing this thesis.

Thank you.

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Exploring Students' and Teachers' Perspectives in AI-supported Classrooms

Artificial Intelligence (AI) is rapidly transforming various sectors, and education is no exception. AI-powered applications are becoming an integral part of the classroom environment, enhancing the teaching and learning process and revolutionizing traditional models of education. However, to effectively integrate AI applications into real-life classrooms, it is crucial to consider the needs of the primary stakeholders: What are students' and teachers' perspectives on learning and teaching with AI? Additionally, where do their perspectives align or diverge?

AI in School Classrooms

AI has the goal to solve cognitive problems traditionally associated with human intelligence, e.g., learning, problem solving, pattern recognition. By doing so it can guide systems in replicating human cognition and behaviors (Chassignol et al., 2018; Wartman & Combs, 2018). Artificial Intelligence in Education (AIED) extends to providing personalized learning experiences, delivering educational content, and supporting real-time decision making for students and teachers. AIED encompasses various AI technologies—including chatbots, robots, and automated assessment tools—that collectively aim to enhance and support educational practices (Chiu et al., 2023).

The integration of AI in education has expanded to include various applications, such as personalized learning environments and instructional support adapted to students' knowledge levels (Ritter et al., 2016). A prominent example are Intelligent Tutoring Systems (ITSs). These systems interact with students by presenting information, assessing their knowledge, and providing immediate personalized instructions and feedback (Kokku et al., 2018; Kulik & Fletcher, 2016). ITSs adapt their instruction based on the students' evolving knowledge state (Ahmad et al., 2021). Classroom implementations of such systems have been shown to have a positive impact on student learning outcomes, often outperforming traditional teaching methods and other educational technologies (Nye, 2014; Pinkwart, 2016).

A key question concerning the use of AI in the classroom is to what extent AI will replace or complement human teachers. While some scholars have explored the potential of AI to replace teachers (Blikstein, 2018), a more prevalent perspective supports AI with the goal to augment human intelligence. Molenaar (2022) suggests AI that analyzes data and generates insights to inform pedagogical actions. This idea is in the scope of "hybrid intelligence" (Akata et al., 2020): humans and AI, working together to leverage their complementary strengths. Molenaar's Detect-Diagnose-Act framework illustrates this vision, describing how AI collects data (Detect), analyzes it to diagnose learner needs (Diagnose), and takes pedagogical actions (Act). These actions may include adaptive interventions, such as curriculum adjustments or task recommendations that enhance the learning process (Molenaar et al., 2021).

Another model in line with the hybrid approach is The Six Levels of Automation in AI for Education Model (Molenaar, 2022). This framework describes different levels of control between teachers, students, and AI, ranging from full teacher control (Level 1) to full AI automation (Level 6). Notably, this model emphasizes the importance of conditional automation (Level 4), where AI supports rather than replaces human skills. This model also highlights the role of interfaces, such as dashboards, that facilitate two-way interaction between AI and teachers, ensuring that the role of AI enhances rather than limits teacher agency.

AI's role in education is increasingly seen as a collaborative partnership with educators (Holstein et al., 2020). Effective AI systems should enhance the teachers' agency while leaving room for human-human interactions (Holstein et al., 2017). By augmenting teachers' real-time awareness of classroom dynamics, AI systems can direct attention to individual needs of their students (Aleven, Roll, et al., 2016). AI also streamlines administrative tasks such as grading, thereby allowing teachers to spend more time on instruction and student engagement (Sharma et al., 2019).

Many applications of AI in the classroom primarily involve assessing student knowledge and tailoring learning content to individual performance (Aleven, McLaughlin, et al., 2016). However, many ITSs are not developed with the needs of teachers in mind. This often leads to artificial use cases that do not reflect the reality of the classroom. As an example, (Olsen, 2018) highlights a major challenge in designing ITSs by incorporating the needs of teachers and the environment in which it takes place: "[H]ow to balance between the automation that the system can provide and the autonomy provided to the teachers over their own classroom." Failing to consider the needs of the primary users can undermine the effectiveness of the system (Olsen, 2018). Holstein et al. (2017) pointed to the need for more teacher-centered design, where ITSs include features such as dashboards that help teachers monitor and guide student learning activities in real time. In addition, orchestration tools offer promising solutions by capturing, analyzing, and visualizing student activities during instruction, thereby supporting teachers in real-time student support (Van Leeuwen et al., 2018). Such tools are an example of the hybrid approach to AI, in which teachers retain decision-making authority while being supported by AI recommendations. For example, as reported by Echeverria et al. (2023), the successful integration of AI tools often depends on a balanced distribution of decision-making power among AI systems, teachers, and students. Teachers in high-performing classrooms reported allowing students to autonomously select partners, while in low-performing classrooms, shared orchestration between AI and teachers allowed AI to suggest pairings, with teachers having the final say (Holstein et al., 2019b).

It is crucial that the deployment of ITSs in educational settings is carefully managed to ensure they meet the unique needs of both educators and learners. While ITSs can significantly enhance the educational experience, there is a need to preserve the human aspects of teaching and learning, such as decision-making, autonomy, and interactivity in the classroom. This balance ensures that technology supports rather than undermines the critical roles that teachers play in fostering creativity, empathy, and other human-centric skills in

students (Holstein et al., 2017, 2018; Olsen, 2018; Wetzel et al., 2018).

How Teachers Perceive and Use AI in the Classroom

For AI systems to be successful in collaborating with teachers (instead of replacing them), teachers play a critical role in guiding and shaping how systems should be used (L. Chen et al., 2020). Their involvement ensures the "human-in-the-loop" approach: teachers actively optimize AI tools to meet educational goals. A significant body of research has identified three main ways that teachers are using AI in their practice. First, AI-enhanced ITSs assist teachers by recommending personalized instructional content and tasks tailored to individual student needs. Second, AI technologies and computer-assisted instruction tools help teachers manage classrooms more efficiently by automating tasks such as distributing materials and tracking performance. Third, AI systems also support teachers' professional development by providing automated feedback based on classroom observations and assessments (Chiu et al., 2023).

One area in which AI has proven particularly useful is in providing teachers with real-time, actionable analytics that help them make decisions on the fly. These systems are particularly beneficial in blended learning environments, where students work at their own pace with adaptive technologies while teachers focus on providing individualized support (Holstein et al., 2017). However, teachers are challenged to manage multiple student activities simultaneously and require support in interpreting data from AI systems and translating this data into effective pedagogical actions (Martinez-Maldonado et al., 2013). The implementation of teacher awareness tools further illustrates the potential of AI. Holstein et al. (2018) found that providing teachers with real-time feedback on student learning, behavior, and metacognitive states enabled them to provide immediate and targeted support. This did not only improve student learning, but also highlighted the value of human involvement in increasing the effectiveness of ITSs. It is important that the design of these tools must balance automation with teacher autonomy. Too much automation can interfere

with teachers' ability to control classroom activities and set pedagogical goals, while too little automation can overwhelm teachers with tasks that AI could perform more efficiently (Holstein et al., 2019a).

The potential for AI to improve teacher decision-making is particularly significant when it comes to dashboards that monitor student behavior and performance. Research by Van Leeuwen et al. (2018) found that teachers value dashboard features that inform them about student understanding and highlight issues, such as software misuse or low performance. Teachers also reported that they needed additional support to interpret this data and translate it into meaningful instructional actions. The success of these dashboards therefore depends not only on the data provided, but also on teachers' ability to use it effectively.

There are some prevalent concerns among teachers about using AI: Some fear that AI will diminish their role in the classroom and lead to a more dehumanized educational experience (Herawati et al., 2024). They emphasize the need for more hands-on AI training for teachers. And they raise concerns about a lack of transparency of how AI tools make decisions. Despite the potential benefits, many teachers struggle to adopt AI technologies due to a perceived loss of control and reduced self-efficacy (Chiu et al., 2023). In addition, the design of ITSs often fails to adequately consider how these tools will be integrated into teachers' workflows (Holstein et al., 2017).

How Students Perceive and Use AI in the Classroom

Chiu et al. (2023) identify three primary functions that AI serves for students. First, AI systems are used to personalize task assignments based on individual competencies. Second, AI provides timely and precise feedback by analyzing students' work. Third, AI enables interactive and adaptive learning environments by capturing, analyzing and adjusting materials to learning data. Feng et al. (2024) highlight that ITSs can help reduce achievement gaps in heterogeneous learning groups by providing equitable access to personalized

instruction.

Student attitudes toward AI reflect a complex mix of curiosity, skepticism, and concern. Idroes et al. (2023) explored students' perspectives on AI in educational settings and found that 68.1% of students expressed curiosity about the potential of AI, although only 7.7% reported a high level of trust in these systems. This indicates a general interest in AI, but also a significant level of anxiety, with some students fearing the potential societal impacts of AI, such as job displacement or privacy concerns. The study also highlighted students' concerns that AI could reduce face-to-face interactions between students and teachers, as well as the potential risks of system failure or internet addiction. Despite these concerns, most students see AI as very useful in education. A majority of respondents in the Idroes et al. (2023) study said they appreciated AI's ability to support teachers by providing virtual assistants to help with teaching and answering students' questions in real time. This reflects a growing appreciation for AI's role in improving the efficiency and interactivity of classroom learning, as well as increasing access to education.

Sumakul et al. (2022) found that students are more likely to adopt AI technologies if they perceive them to be user-friendly and beneficial to their learning. Student perceptions play a critical role in the successful integration of AI in the classroom, as positive attitudes toward these tools correlate with their effective use in educational settings (Nye, 2014). This underscores the importance of designing AI systems that are not only powerful, but also accessible and easy for students to use. Students' familiarity with AI can influence their willingness to engage with these technologies. Marrone et al. (2022) found that students with a better understanding of AI are more likely to embrace its use in the classroom. On the other hand, students who are unfamiliar with AI may be more resistant to its adoption. This suggests the need for increased exposure to these technologies to address students concerns.

Research also highlights the challenges students face when using ITSs. Aleven et al. (2003) found that learners often misuse or ignore offered help within ITSs, which can

negatively impact learning outcomes. Students with limited prior knowledge often struggle with deciding when and how to seek help. This suggests a need for AI systems that not only provide subject-specific knowledge, but also teach students metacognitive learning strategies, like how to seek and use help effectively.

Student Agency When Learning With AI

Defining student agency as an "individual's ability to act and cause changes during the learning process" (Hooshyar et al., 2023) emphasized the importance of empowering learners to take control of their learning path, to make decisions, and to influence their results based on their actions and choices. As AI-enhanced educational technologies become more common, they present both opportunities and challenges for fostering student agency. AI systems can provide students with greater control over their learning paths, content pacing, and feedback, empowering them to take ownership of their learning (Bodily & Verbert, 2017; Damgaard & Nielsen, 2018). But there is a tension between the potential of AI in enhancing student autonomy and the risk of reducing it by over-automation of the learning process (Darvishi et al., 2024). AI can support students in developing self-regulation skills and making informed decisions (Molenaar et al., 2020, 2021). But these systems may also interfere with students' ability to make autonomous decisions about their learning trajectories (Bergamin & Hirt, 2018). This reliance raises concerns about the long-term development of metacognitive skills and learner autonomy when students use more AI-enhanced educational systems (Aleven & Koedinger, 2000; Long & Aleven, 2011; Molenaar et al., 2019).

However, simply focusing on maximizing student agency in AI-based learning systems is not the solution. It has been theorized, in line with Self-Determination Theory, that a high level of student agency leads to higher levels of engagement, interest, and motivation, which in turn leads to higher motivation and better learning outcomes (Sasikala & Ravichandran, 2024; Wang et al., 2023). An autonomy-supportive environment is critical in promoting both personal growth and improved academic performance by addressing students' intrinsic

psychological needs for competence, autonomy and relatedness (Ryan & Deci, 2000; Yang & Aurisicchio, 2021). In one study, increased perceptions of control were associated with higher levels of direct and relative enjoyment and perceived competence (Cordova & Lepper, 1996). On the other hand, high levels of student agency can lead to less desirable learning outcomes. Many students are overwhelmed by the complex task to monitor and regulate their cognitive, metacognitive, and affective processes (Molenaar et al., 2019; Winne & Azevedo, 2014). Too much freedom and too little support leads to struggle to select, organize and integrate relevant information (Sawyer et al., 2017). This shows that AI-systems should provide a balance between regulation and freedom. Echeverria et al. (2023) and Holstein et al. (2019a) revealed that students want to retain some control over decisions in AI-enhanced learning environments and resist the notion of teachers or AI systems having complete authority.

Traditionally, student agency has been viewed as a one-dimensional concept, with high and low levels of control (Holmes & Tuomi, 2022). However, Vincoli (2023) argued that agency in AI-supported environments encompasses not only control over learning content, but also decisions about data sharing, collaboration with peers, and the amount of help or feedback received. These different facets of agency could impact both learning and motivation. In rethinking agency in AI-powered learning environments, it becomes clear that fostering student agency is not simply about giving students more control, but about ensuring that this control is meaningful and supportive of their learning goals. This requires a careful balance between the autonomy AI provides and the guidance needed to prevent unproductive behavior.

Understanding Differences and Similarities Between Teachers and Students on AI Use in the Classroom

While studies about this topic are still rare, one study, conducted by Holstein et al. (2019a), identified several areas of commonality between teachers and students, as well as notable differences in their expectations. In the study, teachers and students were presented

with a series of hypothetical cases of AI use in the classroom in the form of storyboards and asked how they would feel in these situations. They found that both students and teachers agree on certain key features of AI in education, but they have differing views on its role and implication.

First, both students and teachers agreed that AI can be a tool to improve learning efficiency and teaching practice. However, students are concerned about the level of monitoring and control that AI systems could impose. They are concerned about how their data will be used, particularly in systems that share emotional or behavioural data with teachers. They prefered systems where they have control over what information is shared and can choose when to disclose sensitive data, such as frustration or confusion (Holstein et al., 2019a). In contrast, teachers prioritised AI systems that have students share their data to provide real-time insights into student frustration, misbehaviour or performance trends, allowing teachers to provide more personalised instruction, improve explanations and respond quickly to student needs. In this line, teachers also preferred features that rank students based on their need for help, allowing them to prioritise support for those who struggle the most (Holstein et al., 2019a).

There are similarities in how students and teachers perceive AI's role in providing emotional and motivational support. Teachers generally appreciated AI's ability to incorporate gamification to motivate students, but are critical of automated motivational prompts. They believed these could undermine their ability to provide genuine emotional support. Similarly, students found such automated encouragement impersonal and less effective than human interaction. In summary, both groups prefered authentic, human-driven emotional support, reinforcing the value of maintaining human relationships in educational settings (Holstein et al., 2019a).

Another area of agreement between students and teachers is control over data analysis. Teachers were supportive of AI's ability to monitor classroom dynamics and provide

insights, but skeptical of systems that allow students to completely hide their analytics. They argued that such hiding could hinder their ability to intervene when necessary and effectively support students. Interestingly, while students valued the ability to control certain types of analytics, such as emotional states, they also recognised the need for transparency when their performance drops significantly. This shared understanding suggests a middle ground where selective data sharing could satisfy both groups' needs for privacy and effective intervention (Holstein et al., 2019a).

In addition, both teachers and students were reluctant to use AI features that displayed students' skill mastery levels to their peers because of the potential for social consequences such as teasing or embarrassment. This finding highlights the sensitivity around publicly sharing individual performance data, with both groups agreeing that such information should remain private to maintain a supportive classroom environment (Holstein et al., 2019a).

Moreover, both teachers and students agreed on a feature of AI systems that allows students to privately signal for help, such as an invisible hand-raise feature. This feature allowed students to discreetly request help without fear of embarrassment in front of their peers, while teachers benefited from being reminded to address these requests if they went unnoticed for too long. This system was seen as an effective way of supporting students who may be reluctant to ask for help publicly, improving overall classroom communication and ensuring that all students' needs are met (Holstein et al., 2019a).

To summarize, teachers focused on the AI's ability to streamline classroom management and improve instructional efficiency, while students were more concerned with privacy, control over data, and maintaining human connections. To successfully integrate AI into the classroom, these different perspectives must be carefully balanced. Developing AI systems that respect student privacy while empowering teachers to provide targeted support can create a more harmonious and effective learning environment where human and machine

intelligence work in tandem. Holstein et al. (2019a) provided valuable insights into the areas where student and teacher perspectives on AI-enhanced systems align and diverge. However, their study does not specifically consider the role of student agency across the four primary dimensions of hybrid human-AI control in the classroom. In addition, the comparison of student and teacher preferences focuses primarily on contrasting their most and least preferred concepts and features, which may overlook subtle nuances and connections between the two groups. Furthermore, students and teachers from cultural contexts outside the US, where AI-based learning systems are more prevalent (X. Chen et al., 2022), may have different preferences regarding their desired level of control over AI systems and how they want to interact with them (Koedinger & Aleven, 2007).

Present Research

Teachers have traditionally been seen as the primary facilitators of knowledge in the classroom (Nye, 2014), but with the rise of AI, they are now sharing their instructional responsibilities with AI systems. While these systems offer significant benefits, they also raise concerns about privacy, control and the impact on autonomy. Moreover, the involvement of key stakeholders, such as students and teachers, in the development of AI systems is crucial for successful implementation, yet this is often overlooked (Baker, 2016; Dillenbourg & Jermann, 2010; Nye, 2014; Xhakaj et al., 2016). This leads to systems that do not meet their needs and preferences (Chiu et al., 2023; Holstein et al., 2019b).

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needs and preferences (Chiu et al., 2023; Holstein et al., 2019b).

For AI systems to be truly effective, it is important to identify both the similarities and differences in how students and teachers perceive and interact with them. We need a deeper and more nuanced understanding of these perspectives, which will form the basis for designing systems that facilitate, rather than hinder, teaching and learning in AI-supported classrooms (Holstein et al., 2017, 2019a; Olsen, 2018; Van Leeuwen et al., 2018).

This study aims to bridge the gap between students' and teachers' autonomy when using AI-based systems in the classroom. The study was conducted to answer two questions: (1) What are students' and teachers' preferences about how much control they want to have over decisions made by AI systems in the classroom? and (2) What are the differences and similarities between teachers' and students' perspectives on student agency?

To this end, together with other members of the lab, we developed eight scenarios each from the perspective of a student and a teacher, covering all four dimensions of agency. The scenarios were chosen to range from complete control of the learner to complete control of the AI. By presenting these scenarios from the perspective of both students and teachers, this study offers unique insights into the perspectives of both parties.

While most of the research on AI in education has been conducted in the US (X. Chen et al., 2022), it is important to recognize that cultural norms, pedagogical traditions, and educational values differ significantly across countries. These differences may influence how students and teachers perceive and interact with AI-based educational tools (Lawter & Garnjost, 2021; Putman & Crossley, 2022; Roach & Byrne, 2001). Regarding the increasing integration of AI systems in German classrooms (mmb Institut – Gesellschaft für Medien- und Kompetenzforschung mbH et al., 2023; Vo & Pancratz, 2023), it is essential to gather more information in the context of German schools. The following study provides the basis for this by analysing the needs, concerns and expectations of German students and teachers in AI-enhanced classrooms.

Methods

To uncover the similarities and differences in students' and teachers' views on AI use in the school classroom, a qualitative study was conducted to explore their preferred levels of agency when interacting with AI-based learning systems. The study focused on determining how much control AI or student should have in decision-making during the learning process.

Positionality Statement

This work is a direct extension of a previous study that focused on students' perspectives regarding the integration of AI-based systems in the classroom (Vincoli, 2023). The previous research explored the ways in which students prefer to interact with AI technologies, their concerns regarding privacy and autonomy, and the level of control they wish to maintain in their learning processes. The results of this initial study provided valuable insights into the ways in which AI affects students' roles and agency within the educational environment. In this thesis, the same methodological framework was used to explore the teachers' perspectives. The method section illustrates where the teacher study was similar to the student study and where it differed. In the following text, when reference is made to the student study, it always refers to Vincoli (2023). By following a similar methodology of conducting interviews and analyzing the data collected, this research provides a basis for the following comparison of the perceptions and preferences of both students and teachers. A comparative analysis is essential for understanding how different stakeholders perceive the incorporation of AI in education, and for gaining a more comprehensive understanding of the impact of AI systems on classroom dynamics. By using the same interview structure and coding techniques, the research ensures the reliability of comparisons between the findings of both groups. This approach not only increases the reliability of the findings, but also provides a deeper understanding of the similarities and differences in how students and teachers perceive their roles in AI-supported educational environments. By "we" I mean a total of five researchers (three graduate students, one undergraduate student, and

one faculty member from a German university) who are contributing to this research project.

Participants

A total of 16 school-aged students (mean age: 14.18, SD: 2.04, Range: 12-18) and 15 school teachers (mean year of teaching experience: 8.20, SD: 8.28, Range: 0.5-28) in Germany individually participated in the study in 2023-24 (see Table 1). We recruited the participants through direct contacts to their schools or through prior contacts in the lab. The study focused on secondary school students, as secondary schools are typically the primary targets for digitization initiatives in Germany (Mann & Hladkii, 2023). The teachers were selected from various types of schools in Germany to ensure the inclusion of a wide range of perspectives and experiences, thereby obtaining a comprehensive and generalize dataset on teaching with AI.

For both groups, participants were given the option of participating in the study in either German or English and could choose to complete it online or in person. Prior to data collection, the study was approved by the university's ethical review board, consent forms were signed, if needed by the parents or legal guardians of the students (see Appendix B). Participation in the study was on a voluntary basis, and those who took part were informed of the purpose, procedures, and their rights, including the right to withdraw at any time without penalty. The confidentiality and anonymity of the participants were guaranteed, and the data were stored securely and accessed only by the research team. To compensate for their time and effort, students received €12 and teachers received €40 upon completion of the study.

Table 1
Demographics of students (S) and teachers (T)

Participants	Age/Year of Teaching	Grad Level they belong to/ Grade Level they have taught	Subjects they have taught	Interview Language	Participant Mode
S1	16	11th	-	English	In-Person
S2	16	10th	-	English	Online
S3	12	6th	-	English	Online
S4	14	8th	-	German	Online
S5	12	6th	-	English	In-Person
S6	14	7th	-	English	In-Person
S7	13	7th	-	German	Online
S8	17	11th	-	German	Online
S9	12	6th	-	English	Online
S10	16	10th	-	English	Online
S11	13	8th	-	English	Online
S12	12	7th	-	English	Online
S13	16	10th	-	English	Online
S14	18	12th	-	English	Online
S15	12	6th	-	English	Online
S16	14	8th	-	English	Online
T1	10	5th-12th	German, French, Seminar Subject	German	Online
T2	3.5	1st-4th	German, Math, Science, Music, Sport, French, Art	German	In-Person
T3	4	5th-12th	German, History	German	Online
T4	15	5th-12th	German, History, Dramatic Play	German	Online
T5	15	5th-12th	English, German, Sport	German	Online
T6	7	8th, 9th, 10th, 12th	Math, Physics	German	Online
T7	1.5	7th, 8th, 10th, 12th	Math, Computer Science	German	In-Person
T8	2	5th, 7th, 10th, 11th	Math, Physics	German	Online
T9	2.5	3rd	German, Math, Music, Art, Sport, Religion, Supplementary Lessons	German	Online
T10	2	5th, 7th, 8th, 9th	Music, Mathematics	German	In-Person
T11	1	6th-12th	Sport, Physics	German	Online
T12	0.5	6th, 7th	Computer Science, Geography	German	Online
T13	21	5th-9th	Social Sciences, English, Communication & Media, Career & Business	German	Online
T14	10	11th-13th	German, History, Seminar Subject	German	Online
T15	28	5th-10th	German, Art	German	In-Person

Material

This study used a set of materials to facilitate the collection, transcription, translation, and organization of data from interviews with students and teachers about the integration of AI in the classroom. The materials were designed to encourage participants to engage in discourse about the potential applications of AI in the classroom.

Interview Protocol

The interview protocol (see Appendix A) was structured to facilitate the introduction of the study to students and teachers in a comfortable and accessible setting. It was designed to be informal, in a relaxed and conversational style, rather than following a strict, formal structure, in order to facilitate participants' comfort in sharing their authentic thoughts, which was critical to gain a full understanding of their perspectives. We achieved this by first asking them a series of warm-up questions about their demographics, and general perceptions and attitudes toward technology in the classroom, followed by a transition to the topic of AI. Overall, the main questions were adapted for both students and teachers, six for students and five for teachers, as shown in Appendix C1. The questions designed to gain insight into the teachers' perspectives, preferences, and the current context of their teaching practice were different from those asked of the students. We assumed that the teachers would be more active in the discussion and, given their professional training and experience, would be better able to apply the insights gained from the scenarios to their professional training and teaching practice than the students. This assumption was validated through the pilot testing. To ensure students and teacher understand the term AI-based learning technology, a short explanation is given: "When we say AI-based learning technology we refer to intelligent, personalized learning systems that provide feedback, assignments, scaffolding, and assistants based on AI-detected information about student learning (e.g., Bettermarks (bettermarks GmbH, 2023))." Then the participants are shown eight scenarios depicting different situations to implement AI in the classroom. To gain a more profound understanding of their perceptions, experiences, and emotions, participants are asked a set of questions while viewing the scenarios, as detailed in Appendix D1.

Scenario Development

To explore participants' perceptions of AI in the classroom, the speed dating interview method is utilized. The speed dating method is a design approach that enables participants

to engage with a range of futuristic scenarios and provide immediate feedback, facilitating the understanding of participants' needs and desires by researchers and designers (Holstein et al., 2019b; Zimmerman & Forlizzi, 2017). In order to facilitate the study, we prepared illustrative scenarios in a storyboard format, which depicted the potential use of AI in a variety of classroom contexts. This approach was selected due to the fact that AI-based and digital tools are still in the early stages of adoption in German schools. Therefore, it is difficult for students and teachers to imagine potential applications without guidance (Kim & Kim, 2022; Kultusministerkonferenz, 2021; SEKRETARIAT DER STÄNDIGEN KONFERENZ DER KULTUSMINISTER DER LÄNDER IN DER BUNDESREPUBLIK DEUTSCHLAND, 2023). Prior research has demonstrated the efficacy of storyboards in eliciting profound insights into how students and teachers perceive AI technology in the classroom (Holstein et al., 2020; Karumbaiah et al., 2023; Ngoon et al., 2023; Seo et al., 2021; Yip et al., 2023).

The development of these scenarios was based on the multi-dimensional concept of student agency we proposed. Specifically, for each of the four dimensions of agency, two scenarios were constructed (hence a total of eight scenarios): one in which the student exercised complete control (full learner control) and one in which the AI was in complete control (full AI control) (Molenaar, 2022). In the scenarios in which the student had full control, the AI was largely unable to exert any influence, with the majority of decisions being made by the student. In contrast, the full AI control scenarios entailed the AI having complete control, thereby limiting the decision-making power of the student (see all scenarios in Appendix H and I).

The scenarios presented here were developed based on example storyboards from prior design work with teachers (Yip et al., 2023) and empirical studies of AI-based learning systems (Molenaar, 2022; Nguyen et al., 2018). Each of the eight scenarios was constructed with two possible outcomes, one positive and one negative. To visualize, Figure 1 illustrates a scenario within the Content Agency in which students have complete autonomy over the tasks

they work at. Students receive suggested exercises, but can choose what to work on, as shown in the second image. The positive result (4A) shows that students prepared well for the test by following the system's suggestions based on their performance and knowledge. In contrast, the negative result (4B) shows that some students failed the test because they decided on their own which items to work on and are therefore not well prepared.

Figure 1

Teacher Scenario 7: Full learner control over educational content

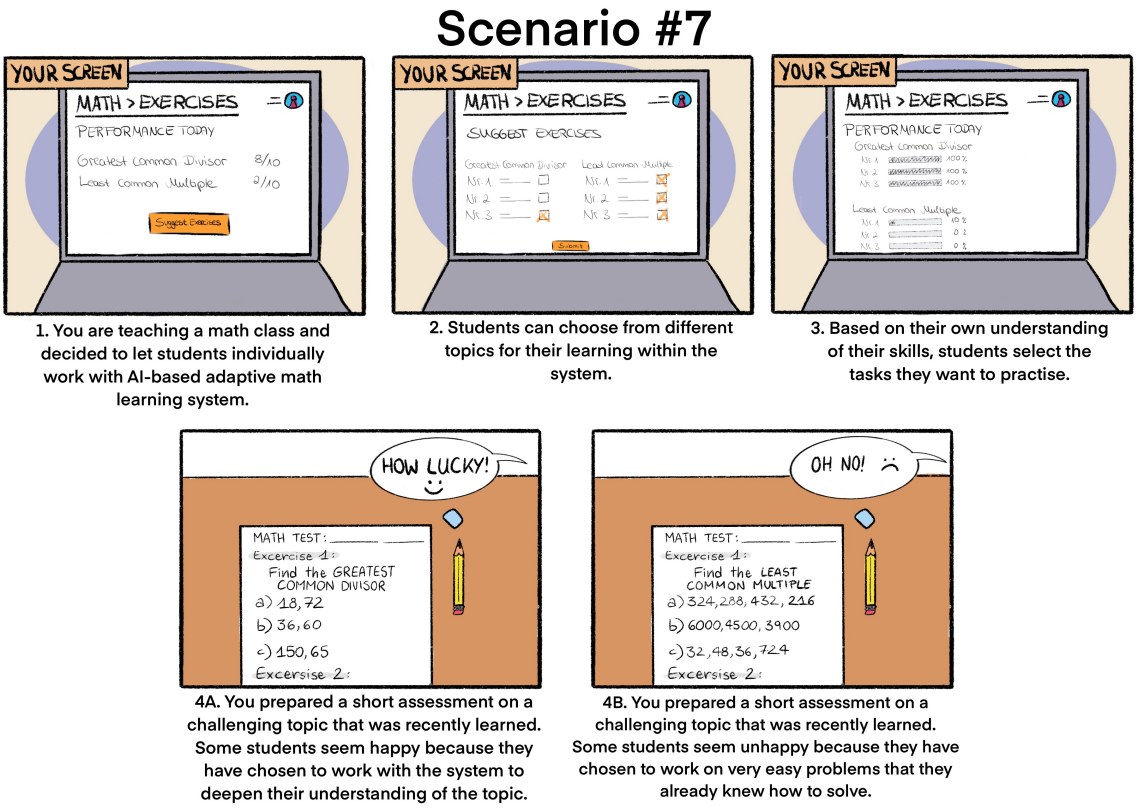
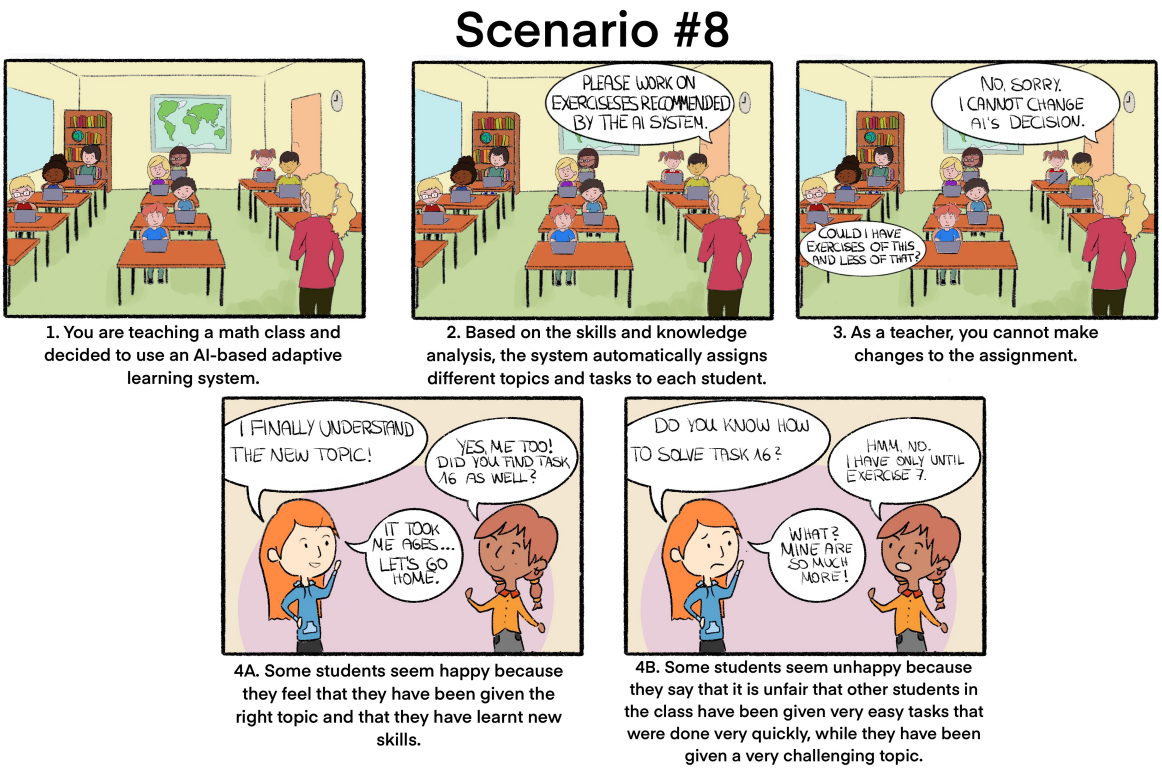


Figure 2 illustrates a scenario within the Content Agency where the AI has complete autonomy over the tasks it gives to the students to work on. The positive outcome (4A) shows that the students are happy to receive tasks from the AI system that help their understanding and learning, while the negative outcome (4B) shows students who seem unhappy because they have been assigned different numbers and difficulty levels of tasks.

Figure 2

Teacher Scenario 8: Full AI control over educational content



We included both positive and negative outcomes to capture the potential variability in student and teacher views depending on the outcomes of AI use. The use of neutral endings was avoided since they have the potential to obscure the participants' interpretations. This makes it challenging to determine whether they view the scenarios in a positive or negative light. The use of clear positive and negative endings allows for the more effective uncovering of hidden needs and desires, as neutral scenarios may prove insufficient for engaging school-aged children and novice teachers in discussions. To ensure unbiased impressions, the study first presented three neutral scenes and subsequently showed the two different endings to stimulate conversation. It is important to note that we avoided the term agency when interacting with participants due to its inherent complexity. Instead, we used more familiar terms such as control and decision-making.

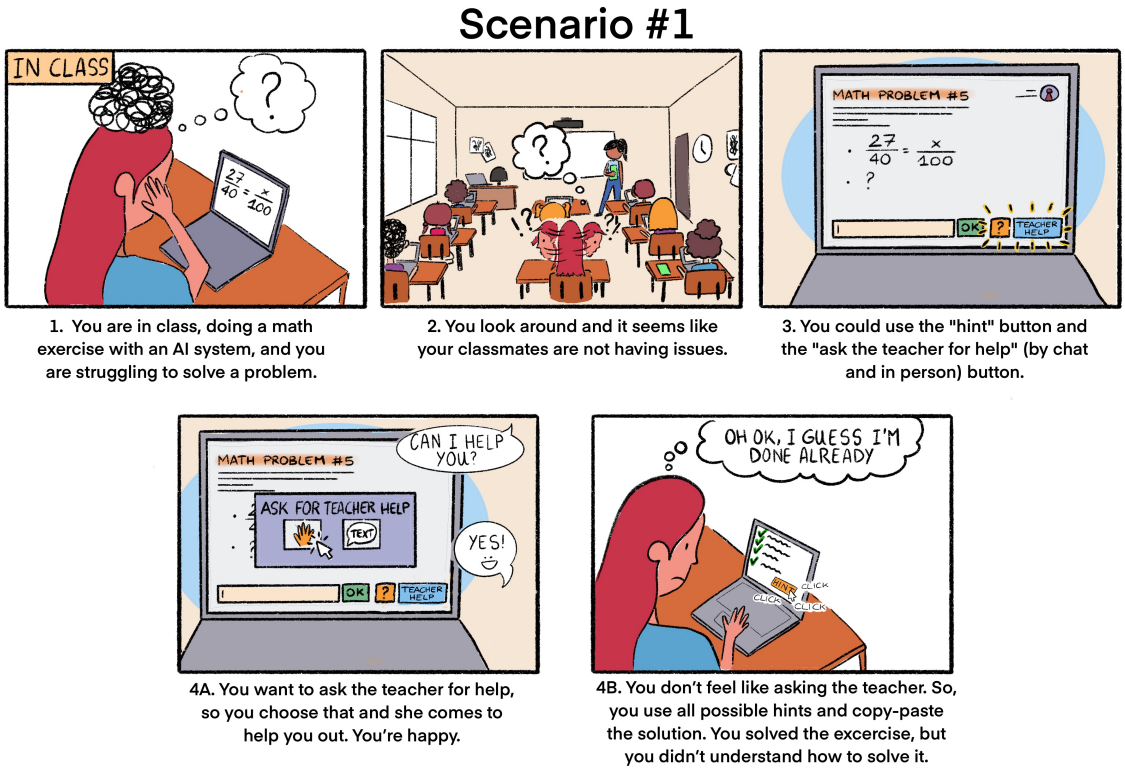
The scenarios were first designed from the students' perspective to make it easier for

them to empathize with the situations depicted (Vincoli, 2023), and then adapted for the teachers to represent their perspective in the classroom. Consequently, the illustrations were created with the teacher's perspective in mind to facilitate their own immersion in the situation. It was also necessary to avoid insisting on a perspective that consistently viewed the situation from the students' point of view. This was crucial in order to gain the insights needed to answer our research question and to gain a full understanding of the teacher's perspective.

The similarities and differences between the student and teacher perspectives are illustrated in the example of Scenario 1 (see Figure 3 and Figure 4). The first image for the student scenario shows an over-the-shoulder view of a girl sitting in front of her computer, interacting with the AI system. In comparison, the first image for the teacher scenario captures a similar over-the-shoulder perspective, but from the perspective of the teacher standing in front of the classroom observing the students. As the scenarios progress, the third image in the student scenario reveals the student interface of the AI system, providing a glimpse of how the student interacts with the system during the learning process. Similarly, the third image in the teacher scenario shows the teacher's interface, providing a look at the real-time data and notifications provided by the AI system that the teacher can use to monitor the student's progress. In image 4A. of the student scenario, the girl interacts with the interface to virtually raise her hand, signaling to the teacher that she needs help. In image 4A. of the teacher scenario, the teacher is seen reaching out to the student who has virtually raised her hand, ready to provide assistance. Image 4B. from the student scenario offers a different perspective: the student, who didn't want to ask the teacher for help, instead used the AI system's hints to reveal the answer to the problem. In image 4B. from the teacher scenario, the teacher approaches another student who relied heavily on hints and asks to give help, but is rejected.

Figure 3

Student Scenario 1: Full learner control over getting feedback and help



1. You are in class, doing a math exercise with an AI system, and you are struggling to solve a problem.

2. You look around and it seems like your classmates are not having issues.

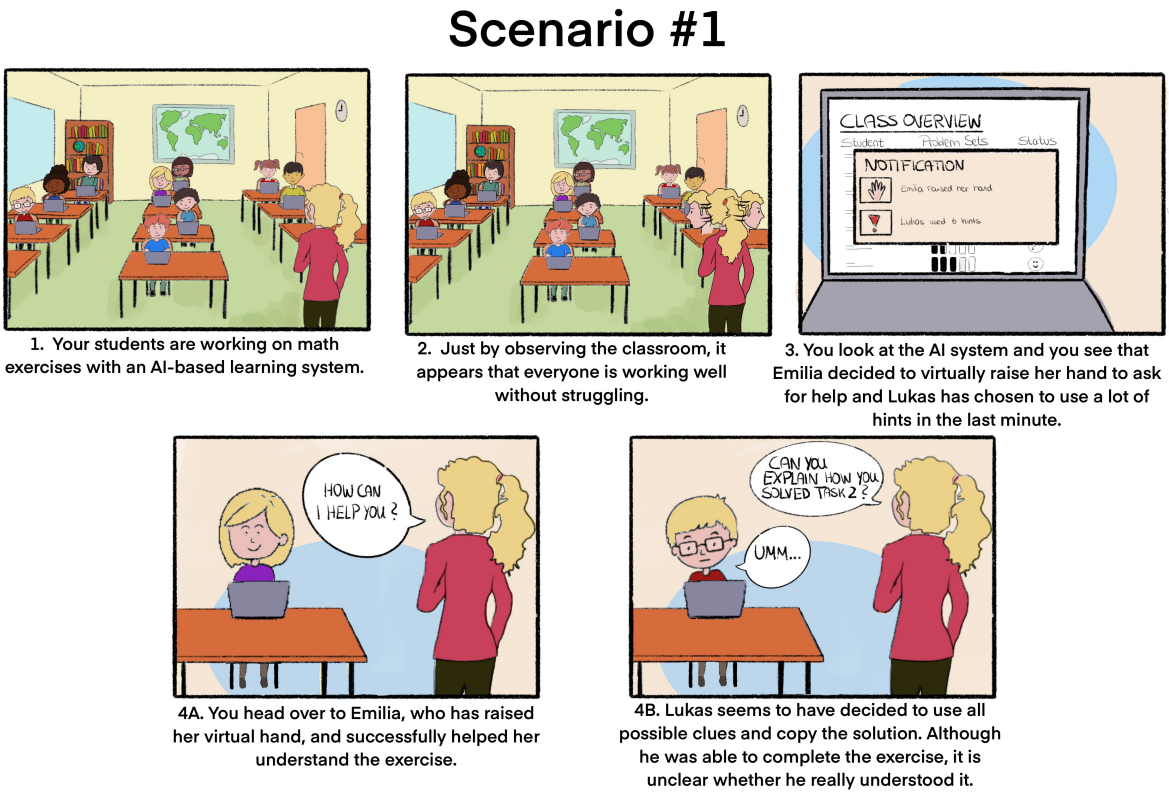
3. You could use the "hint" button and the "ask the teacher for help" (by chat and in person) button.

4A. You want to ask the teacher for help, so you choose that and she comes to help you out. You're happy.

4B. You don't feel like asking the teacher. So, you use all possible hints and copy-paste the solution. You solved the excercise, but you didn't understand how to solve it.

Figure 4

Teacher Scenario 1: Full learner control over getting feedback and help



1. Your students are working on math exercises with an AI-based learning system.

2. Just by observing the classroom, it appears that everyone is working well without struggling.

3. You look at the AI system and you see that Emilia decided to virtually raise her hand to ask for help and Lukas has chosen to use a lot of hints in the last minute.

4A. You head over to Emilia, who has raised her virtual hand, and successfully helped her understand the exercise.

4B. Lukas seems to have decided to use all possible clues and copy the solution. Although he was able to complete the exercise, it is unclear whether he really understood it.

The handwriting and character style varies a bit between the student and teacher scenarios, as they were drawn by two different researchers. However, it was tried to keep the differences as small as possible. In summary, the student and teacher scenarios differ primarily in their perspectives and roles within the classroom. Student scenarios show students interacting with the AI system as a learning tool, using features such as virtual hand raising and hinting to navigate through tasks and ask for help. In contrast, teacher scenarios show the teacher using the AI system to monitor student progress and behavior, receive notifications about student actions, and decide when to intervene. For a comprehensive overview of all potential scenarios, please refer to Appendix H and I.

Study Procedure

The study was conducted in two parts, with each session lasting approximately 50 to 90 minutes. The semi-structured interviews, conducted during the first section of each session (10-20 minutes), aimed to gain further insight into the participants' perspectives and experiences, focusing on their learning and teaching contexts and familiarity with AI. The questions explored how students and teachers generally experience learning and teaching in the classroom and their previous interactions with AI-based learning tools. The second phase of the study was a scenario-based speed dating session (40-60 minutes) designed to introduce students and teachers to potential ways of using AI in the classroom (Zimmerman & Forlizzi, 2017). A variety of scenarios were presented to explore their preferences and perceptions of the optimal use of AI for learning and teaching, with a particular focus on understanding their preferred forms of agency. Participants attended the session either in an online format using Microsoft Teams (Teams, n.d.) and Google Meet (Workspace, n.d.), or in a face-to-face setting in a university laboratory. Thirteen student participants attended the session online, while the remaining three were present in the lab. For the teacher interviews, eleven participants participated online and four participated in the lab. One researcher conducted the entire study, accompanied by another researcher who took notes and occasionally

provided clarification when language or technical issues arose. At least one interviewer was a native German-speaking, and both interviewers were fluent in English.

Each session began with a brief explanation of the study to inform and support participants throughout the interview process. The semi-structured interviews asked warm-up questions about teaching and learning experiences and typical uses of technology in the classroom, including AI-based technologies. In the second section, participants were presented with eight scenarios. This phase introduced participants to potential applications of AI in the classroom, with each scenario designed to explore different dimensions of AI use and agency. Participants are asked to review the scenarios and share their thoughts and opinions about the potential applications presented. The researchers then present two possible outcomes for each situation, which the participants then rate on a scale of one to five (one being "I do not like it very much", five being "I like it very much"). This process is repeated for each of the eight scenarios. The researcher attempts to gain deeper insights into the participants' perceptions by using focused questions. The session ended by thanking the participants for their participation and deep insights, and asking for open questions or additional comments. All participants were recruited to attend sessions individually, except in one case where two student participants attended together at the request of their parents for greater comfort. In this special case, the order of participants was reversed to minimize the influence of one participant's responses on the other. The sessions were video-recorded for later analysis, with the exception of one session in which the participant allowed the researchers to take notes without recording.

Analysis

The study with students generated approximately 14 hours of recording (Vincoli, 2023), while sessions with teachers resulted in approximately 17 hours of recordings. After all study sessions were completed, these recordings were transcribed using the automatic transcription tool of Microsoft Teams (Teams, n.d.). Where necessary, the transcripts were

translated from German to English. To ensure the accuracy of the translations and to maintain the integrity of the original content, three researchers reviewed the transcripts together and made any necessary adjustments.

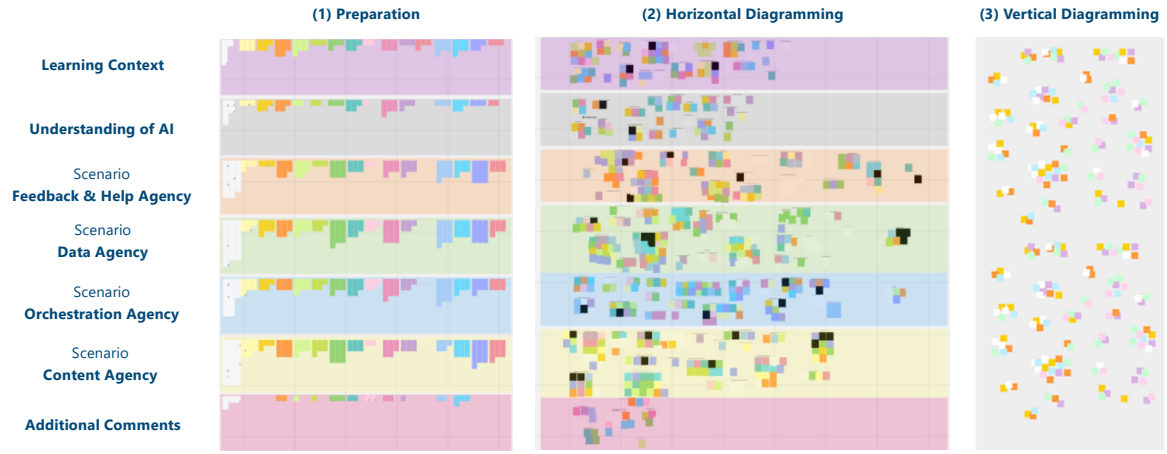
We chose Affinity Diagramming (AD) as analytical approach because of its applicability and precision in organizing and interpreting qualitative data. This method is used to organize related observations, ideas, concepts, or findings into distinct clusters (Krause & Pernice, 2024). AD was considered most appropriate for this study compared to other qualitative analysis methods because it is a flexible, creative, and group-oriented approach that requires a cognitive understanding of the topic under study (Aung et al., 2016). Holtzblatt et al. (2005) described AD as "a technique used to externalize, make sense of, and organize large amounts of unstructured, wide-ranging, and seemingly disparate qualitative data." Common uses of AD include analyzing contextual inquiry data problem for framing and idea generation (Geyer et al., 2011). Thus, this approach is well suited for the study, which aimed to derive design suggestions for AI-enhanced learning systems in the classroom in a later stage of the project in which the study is based. The AD process generates a diagram that is constructed using a hierarchical approach to conceptualization. Consequently, label developing can be interpreted as a representation of the key factors, while the super header can be viewed as a representation of the primary factor influencing the results, as emphasized by Charmaz (2008).

Prior to the application of AD, it was necessary to prepare the data. Three researchers undertook an independent review of the interview transcripts, noting specific phrases or ideas that they considered to be of significance. These observations were transcribed on sticky notes, which included direct quotations from the participants, a brief descriptive summary, and a corresponding code. Coding is the process of identifying segments of meaning within the data and labeling them with codes, which are short phrases that summarize the essence of a particular segment of data. Saldaña (2013) defined a code as “a

word or short phrase that symbolically assigns a summative, salient, essence-capturing, and/or evocative attribute for a portion of language-based or visual data". The process of developing codes was inductive, whereby the codes were derived directly from the data, as opposed to being imposed by preconceived categories (Thomas, 2003). This approach guaranteed that the analysis was firmly anchored in the authentic responses of the participants, rather than being limited by preconceived categories. This initial step allows researchers to break down the data into manageable chunks and facilitates the identification of thematic similarities across the dataset.

The sticky notes created during the coding phase, a total of 1293 (644 from student data, 637 from teacher data), were then transferred to a digital whiteboard tool, Miro (Miro, n.d.) (see Figure 5 "(1) Preparation"). We began by organizing the data according to the study procedure, ensuring consistency across the seven sections (Learning Context, Understanding of AI, Scenario Feedback & Help Agency, Data Agency, Orchestration Agency, Content Agency, and Additional Comments). This preliminary organization was of great importance in maintaining the integrity of the data while facilitating the free exploration of emerging themes. The first stage of data analysis was conducted by using a horizontal

Figure 5
Process of Affinity Diagramming



approach, which we refer to as Horizontal Diagramming, with the goal of identifying common

themes across participants within each of the seven sections of the data set. Within each section, the sticky notes were grouped according to their thematic similarities, allowing the researchers to identify patterns within each dimension of agency (see Figure 5 "(2) Horizontal Diagramming"). The goal was to ensure that each sticky note was related to the others in its group, thereby facilitating the formation of coherent and meaningful clusters. Then, for each group, a heading/label is formulated to represent that group and to build low-level themes (see Appendix E). While the sticky notes identify interesting information in the data set, the themes that are formulated in this step are broader and involve active interpretation of the quotes and the data. Therefore, by starting with the sticky notes, an attempt is made to collate the codes into broader themes that say something interesting about the data set (Holtzblatt & Beyer, 2015).

Second, after completing the Horizontal Diagramming, we proceeded with a vertical approach, which we refer to as Vertical Diagramming. This was conducted to identify themes present across different sections of the data set (see Figure 5 "(3) Vertical Diagramming"). This phase of the analysis allowed the researchers to identify overarching patterns and themes that were consistent throughout the interview process. The vertical diagramming process facilitated a comprehensive understanding of the connections between different aspects of the data, allowing the researchers to gain broader insights into the participants' experiences and perspectives on agency (see Appendix F).

In the final stage of the analysis, we integrated and reorganized the grouped sticky notes based on the overarching themes identified in the second stage, the Vertical Diagramming. This reorganization enabled the formulation of high-level themes that captured the participants' perspectives on agency in AI-based learning systems (see Appendix G).

The AD method was first applied separately to the data collected from students and teachers to examine their different perspectives on AI-supported systems in the classroom. To thoroughly address the research question, it was necessary to analyze and contrast both

student and teacher viewpoints. To achieve this, we combined low-level themes identified during the Horizontal Diagramming stage from each group's data. For each low-level theme in the student data, we searched for corresponding or competing themes in the teacher data. For instance, the student theme "My teachers try to help us" was paired with the similar teacher theme, "In the classroom, it is my job to help the students learn." Sometimes we found competing quotes within the student or teacher data, as shown in Figure 6. If they fit into the overarching theme, we decided to include them as well. Meanwhile, for the student theme "Hints provided by the AI system are not very useful for me," we found a contrasting teacher theme, "Hints from the AI system can be a useful way to assist students," thereby forming a pair of competing themes.

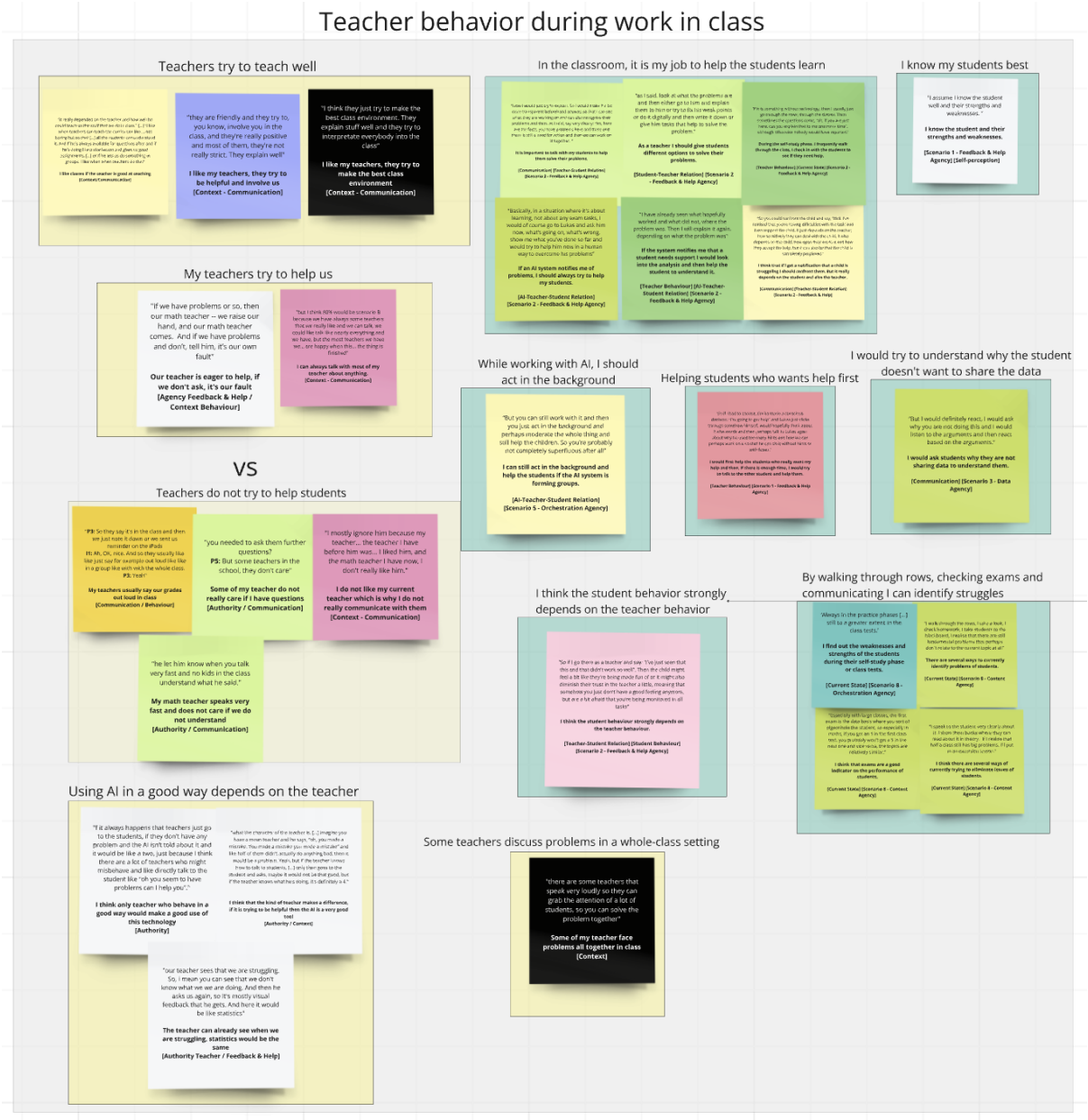
In total, 55 such pairs of low-level themes were generated. Some meaningful low-level themes that contain important statements (e.g., speaking against paired statements) were also combined. For example, as shown in Figure 7, we decided to keep these quotes because they strongly argued against the grouped student and teacher theme "Using AI to ask for help". Themes that could not be paired with corresponding or competing themes were discarded.

Following the AD method, these low-level pairs were then grouped into 13 mid-level themes, representing larger ideas or categories. By grouping these mid-level themes, we identified five high-level categories that encompassed both student and teacher perspectives. After defining these categories, we revisited the mid-level themes to organize them into the four dimensions of agency that form the conceptual foundation of the study. These dimensions were determined based on the frequency of quotes in each group. For example, if a mid-level theme contained 14 quotes coded as Feedback & Help Agency and 4 quotes coded as Content Agency, the theme was categorized under Feedback & Help Agency. This sorting process was justified because interviewees often referred to multiple dimensions of agency, even when discussing about a specific one. This method allowed us to closely examine the

data, reveal nuanced similarities and differences in how students and teachers perceive AI-based learning systems and provide deeper insights into their views of student agency in the classroom.

Figure 6

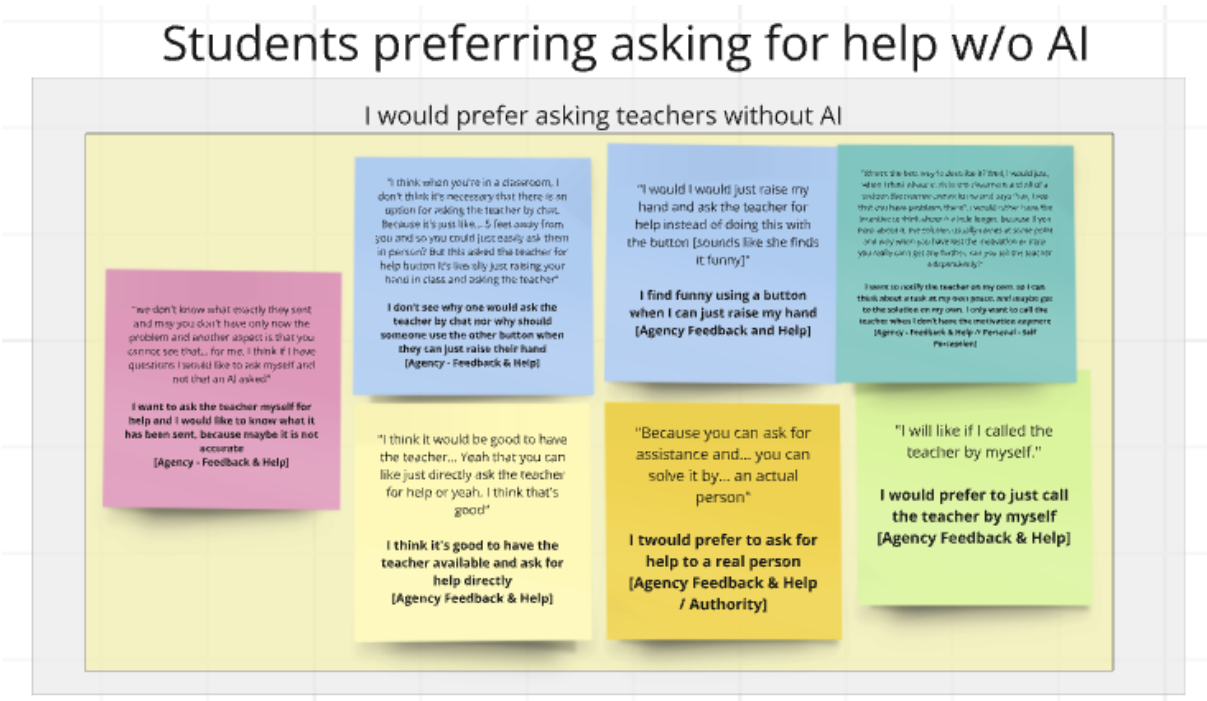
A partial view of our affinity diagram, showing quotes within the pairing



Note: Student quotes are in yellow boxes on the left, teacher quotes are in green boxes on the right.

Figure 7

A partial view of our affinity diagram, showing student quotes without fitting partner



Note: Student quotes are in yellow box.

Results

The analysis revealed key insights into students' and teachers' perception of AI-based learning systems in the classroom. In the following subsections, we discuss students' and teachers' views on their preferences for control and assistance of AI in classrooms, and their perspectives on the use of AI to enhance learning, support students, and assist teachers. While there are many areas of agreement between students and teachers, there are also clear differences in their perspectives. Both groups recognize the importance of trust, social aspects, and an appropriate balance in the relationship between teacher, student and AI. However, teachers tend to focus more on the broader implications and management of AI, while students emphasize their personal experiences and preferences. The comparison resulted in producing five key themes, highlighting similarities and differences between teachers and students: Students' and Teachers' Relationship to AI in the Learning Process, AI Monitoring and Perception of Judgment, Help Seeking, Data Sharing, Students Autonomy and Decision Making. After that, we will illustrate how their views were similar or different within each of the agency dimensions (Feedback & Help Agency, Data Agency, Orchestration Agency, and Content Agency).

Key Themes in Students' and Teachers Perspectives on AI in Education

Students' and Teachers' Relationship to AI in the Learning Process

We found some similarities and differences in students' and teachers' perceptions of AI and how much they would trust its decision making. Students show a mixed level of trust in AI. While they recognize AI-based learning systems as a potentially valuable tool ("I'm curious to learn with AI") and think that AI can be a supportive tool for their learning ("I think AI choice is good, it might know me better than me"), they also express significant distrust in AI decision making ("I don't trust AI's decision making"). This mistrust seems to be based on their understanding that AI lacks the ability to make human-like judgments, particularly in understanding the social factors that influence learning ("AI cannot detect my

mood, which is crucial"; "AI doesn't know me well enough"). For example, one student talked about how AI is not able to recognize appropriate tasks for students and that the teacher is better at this: "[It] would be that [the assigned task] doesn't match perfectly or it's not that helpful. And I feel like sometimes teachers do have a little better connection to their students and so they understand a lot better what the student can really need. And I feel like the AI sometimes doesn't really see that and it's not that helpful at some point and so I feel like a teacher seeing the assigned homework but also being able to like find a better match for the student would be more ideal."

It is noteworthy that there is a difference of opinion among students about the extent to which they would trust AI and its decisions. The range is from reported distrust to confident statements that they trust AI ("I have the knowledge to trust AI"). What all students have in common, whether they trust the decisions of AI or not, is that they see the teacher as the central figure in the classroom. They recognise AI as a support tool for the teacher ("AI can help teachers"), but make it clear that AI should be a support and not a replacement for the teacher ("AI should just be a supportive tool for students and teachers"), and that teachers must have authority over the AI system ("AI should assist teachers, not overrule them").

Similar to students, teachers shared that they do not fully trust AI decision making due to limitations and potential risks. Their concerns include the accuracy of AI assessments ("AI can make mistakes") and the impact on student motivation when AI errors occur ("Students are unmotivated when the AI makes wrong decisions"). One teacher illustrated a situation where "the AI suggests [a task] and says: "Look here, this and this student should do this and this again now." I'm like, yes, that's wonderful. Yes, and if I don't think so, I say no, he's really doing it for the 17th time. Yes, and he's somewhere completely different here. I have to do something else [...] I would like to intervene." They think that "[s]tudents would tolerate mistakes by the teacher but not by the AI system," which is why they emphasize the

importance of always being able to intervene and change the AI's decision.

Furthermore, they recognize the potential mistrust of the students towards the AI due to its inability to recognize social aspects and therefore emphasize their responsibility to maintain the social aspects of the classroom when integrating the AI ("As a teacher, I need to keep the social aspects in mind when working with AI"). Contrary to students' thoughts that they would trust human teachers more than AI systems, some teachers are concerned that students would trust AI more than teachers when it comes to decision making ("Students trust AI more than me"). Teachers feel this way because students might think that teachers make decisions with certain intentions, such as when it comes to grouping, that the teacher intentionally split up groups of friends ("If the suggestion came from me, they would react directly with a defensive attitude. But with an AI system, I would assume that it would be more open-minded"). However, despite their concerns, most teachers see the potential of AI as a supportive tool ("I think AI can be a supportive tool"; "I would like if AI supports me to help students"). Statements such as "I think teacher can't be replaced by AI," "AI should not replace me," "As a teacher I should always be able to interfere" reflect a clear position where AI is seen as a helpful tool but not as a replacement for teachers.

In summary, both students and teachers see AI as helpful for teaching and learning, but agree that it cannot fully recognize students' attitudes and knowledge. Students trust human teachers more, while teachers are concerned that students may perceive AI decisions as fairer and less biased. Both groups recognize AI's potential to assist in the classroom, but agree that it should remain a supportive tool, not a replacement for educational responsibilities.

AI Monitoring and Perception of Judgment

The integration of AI-based learning systems in the classroom has raised significant concerns among students and teachers about the feeling of being monitored. We found that many students talked about feeling uncomfortable being constantly monitored by AI. One

student articulated this by saying, "I would like the AI to analyze my data and guide the teacher in lectures and homework, but not everything should be monitored and shared." This reveals a need for balance - while students recognize the value of AI in supporting their learning and helping teachers in the classroom, they also emphasize the negative impact of feeling constantly monitored: "Feeling monitored stresses me out," which is reportedly caused by being constantly assessed and openly sharing data with teachers and peers. Despite these concerns, many students acknowledged the necessity of data for teachers to effectively guide and support them. One student reflected: "The teacher should always be able to see what you're doing and how well you're doing, because the teacher is the one who's supposed to be helping you with understanding the lesson. And if the teacher can't see this, then there's no way of them helping you. So I guess parents and classmates, I'd be fine with being able to decide if they see it or not. But I feel like the teacher should always be able to see how well you're doing."

This highlights the unique position of teachers as facilitators between AI systems and students' learning experiences. While students are concerned about AI monitoring, they generally agree that it is acceptable if it is used to enhance teacher support. Interestingly, some students view the open sharing of performance data positively, as it allows them to compare their progress with their peers. As one student noted, "I want to compare my performance with others." However, this sense of comparison was also reported to lead to feelings of inadequacy and embarrassment. Poor performance, students reported, often leads to lowered self-esteem: "Mistakes make me feel dumb" and "Poor performances make me feel bad." Some students also expressed concern about being judged by their peers: "I would feel judged by my peers," while others were more neutral: "I don't care what peers are doing." This was reported to be due to the open sharing of data with peers and the resulting pressure in the classroom ("I feel embarrassed to be seen by my peers," "People would make fun of my data").

Teachers also shared concerns about the impact of AI surveillance on student well-being. Several teachers warned that the feeling of constant surveillance could have a negative impact on students: "I think it will have negative consequences if students feel monitored by the system." However, teachers also identified potential benefits, noting that monitoring could motivate students and improve their focus: "I think getting monitored could motivate the students," and "I think it can help students focus and motivate them if they know they are being monitored."

Nevertheless, teachers agreed that constant monitoring is counterproductive and could reduce students' independence. One teacher observed, that "students probably [..] have the feeling that they are being completely monitored from start to finish and no longer have any - any independence at all to decide things for themselves, because it's then predetermined, it's done and everything I do is reported directly back to the teacher. I don't think that's a nice feeling for anyone." They suggested that monitoring should be used selectively, such as in preparation for a class test: "OK, that's total control here. [...] I wouldn't mind using something like this as training, for example in preparation for a class test. [...] I wouldn't do it permanently, but for training purposes you can also discuss with the students where I am at the moment and where I want to go." Both students and teachers shared concerns about the potential for peer judgment arising from open data sharing. Teachers, in particular, noted that peer comparison could be problematic and potentially harmful: "I think peer comparison is problematic," and "Helping a student should not lead to peer judgment."As a result, many teachers argued for limiting the visibility of the data to prevent these problems: "Students should not see the data of peers."

To mitigate the risks associated with AI monitoring, teachers stressed the importance of fostering a supportive and trusting classroom environment. One teacher emphasized the need for open communication: "It's important to create a trusting atmosphere in class so students feel safe asking for help." Another emphasized the importance of transparency in the

use of data to reduce students' fears of making mistakes: "To address students' fears of making mistakes, open communication about data use is important." This findings underscores the need for careful consideration of how monitoring is implemented and communicated. Teachers conclude, that how students feel in the classroom depends on the relationship between the teacher and the students ("I think the feeling of fear and observation depends on the relationship with the teacher").

To summarize, both students and teachers share concerns about feeling monitored by AI in the classroom. While they acknowledge that AI monitoring can have positive effects, such as increased motivation, both groups agree that there must be restrictions. Teachers emphasized the need for trust, communication, and a positive classroom environment to help students feel comfortable with AI monitoring while ensuring that it does not become a source of stress or interfere with their independence.

Help Seeking

Feedback and help are critical components of effective classroom learning. We found that both students and teachers emphasized the central role that teachers play in supporting students. We found, that students face challenges in receiving help. One student noted that "[u]sually, if you want feedback, if you have questions, you have to approach the teacher," while another noted that "[getting feedback] only occurs when we actually ask the teacher directly. I guess only a few times if the teacher has the time to do so, we would get feedback without asking." This highlights a gap between students' needs and their access to help, especially for those who may be uncomfortable asking for help. Students' views of teachers' helpfulness varied, with some expressing doubts ("Teachers do not try to help students"), while others acknowledged that teachers' effectiveness depends on their ability to explain concepts clearly ("it depends on whether the teacher can explain well").

AI is seen as a promising tool to bridge this gap, especially for students who may be shy or hesitant to ask for help. One student shared, "[AI provides] a way for students to ask

for help and every student, if they're shy, they can just text." Students also appreciate that AI can identify their struggles when teachers may not be immediately notice: "It can be good [to get help by the AI], because often the teachers don't notice when you have problems and of course there are also students who don't dare to talk to the teacher or try it for too long themselves and waste time." Students also expressed interest in AI-generated assignments: "I like the idea of getting homework tailored to me by AI." Despite recognizing the potential of AI, students still value direct interaction with teachers. As one student explained that "the teacher coming around and helping you could just like help you understand things a lot better and make you understand where the problem is and so we can explain it better than a hint can." However, they are critical of AI-generated hints, expressing concern that they may not foster deep understanding: "When you talk [... to] the teacher, then they see if you're understanding it and if not, they can help you and with this hints you just do not understand it really well."

Teachers agree that feedback and help are critical to student success. They also see the potential for AI to enhance this process, especially for students who may be more hesitant to ask for help in person. One teacher noted, that "the digital raising of the hand can be a good extension to support the students." Teachers acknowledged that students' willingness to ask for help varies, with some students feeling uncomfortable being the center of attention in a face-to-face interaction. Nevertheless, most teachers reported that students generally take advantage of the help offered, although there are exceptions: "[Some] students don't use help even if they need it." Teachers value AI for its ability to provide a comprehensive view of student performance, especially in larger classes. One teacher noted, "AI helps me get an overview over a lot of students at once". Teachers also highlighted AI's potential to address individual student needs and supplement their own efforts: "AI might be able to give feedback and answers to students, which I might not even be able to." AI's ability to track student progress and save teachers time was also noted as a key benefit. One teacher commented, "I

would like it if AI supports me to help students," and another added, "I think AI can help me identify who needs help."

Teachers generally see AI-provided hints as beneficial, especially for weaker students, although they stress the importance of structured and meaningful guidance: "Students need appropriate scaffolding to help them move forward when they do not understand something." An important point emphasized by the teachers is that they see their responsibilities and actions in the classroom as central to students' learning outcomes: "In the classroom, it is my job to help the students learn". They also believe that students' behavior is strongly influenced by their own approach: "I think the student behaviour strongly depends on the teacher behaviour".

In summary, both students and teachers recognize the importance of feedback and help in the learning process. While AI is seen as a valuable tool that can complement teachers' efforts, especially for shy or struggling students, the personal interaction with teachers remains irreplaceable for many students. Teachers appreciate AI's ability to enhance their work, but they stress the need for careful implementation to ensure that it provides meaningful support rather than superficial solutions.

Data Sharing

Data privacy and sharing emerged as a major concern for both students and teachers, with both groups recognizing the need for clear guidelines and transparency. Students expressed a strong desire for autonomy over their data and emphasized the importance of being informed about how their data is used and shared. As one student said, "I want to have control over my data," while another added, "I would like to know when the AI notifies the teacher." Despite concerns about privacy, students acknowledged the benefits of sharing data when it can enhance their learning experience. Many students noted that sharing data with their teacher could lead to better support in the classroom: "Through what the AI sends to the teacher, you could get a special explanation from the teacher for yourself and then

understand how you can or should do it." They recognize what happens if they choose not to share data: "If you leave everything to yourself, then no one can help you, and if you don't understand a task, then that's it. Then you just don't understand it, but if you just share the biggest part with the teacher, then the teacher can also help you. That also has advantages." Another student agreed to this, stating, "I think that if I do not share anything then no-one can help me, but I see that it would also have advantages for privacy sake."

While students appreciated the assistance that AI systems can provide, they emphasized the need to be careful with their personal information. As one student noted, "I like AI support but the data needs to be handled carefully." A recurring theme among students was the desire for transparency, particularly when it came to knowing what data their teachers could access. They often expressed a need for control over what data was being shared and with whom: "I want to know which data my teacher can see" and "Teachers should only see data about their subject." Concerns about over-sharing were also common, with students warning that excessive data sharing could lead to unnecessary complications: "Sharing too much data can cause trouble."

Teachers were divided on how much control students should have over their data. Some teachers believed that decisions about data sharing should be entirely up to the teacher: "The teacher should decide which data the students need to share." Others argued for a more balanced approach, suggesting that students should have some degree of autonomy over their data: "Students should have some autonomy when it comes to data sharing." Regardless of their position, all teachers agreed that open communication is essential to address concerns about data collection and use. Teachers also acknowledged parents' privacy concerns, noting that parents are often more concerned about data collection than the students themselves. "Parents are more concerned about privacy than their children," noted one teacher, while another noted, "I think it is important to talk to parents about using AI in class." This awareness underscores the importance of engaging parents in discussions about AI use and

privacy, to ensure that all stakeholders are informed and comfortable with the implementation of the technology. Additionally, teachers emphasized the importance of data literacy among students, recognizing that attitudes toward data sharing varied widely: some students expressed little concern about sharing data, while others were more cautious, the teachers concluded: "Students should become data literate."

Despite differing views on the extent of data sharing, teachers generally supported the idea that students should be notified when their data is shared: "The student must always be notified when information is shared." However, some teachers expressed more flexibility in certain situations: "Not notifying students that the teacher has been notified is fine with me." Teachers also recognized the dual potential of data use, acknowledging that it could be both beneficial and harmful depending on its application. One teacher noted, "I think [the data sharing] really depends on how the teacher handles it. If [the teacher is] careful and approach it with empathy, it can be a good thing, but it can also be abused," while another highlighted the importance of respecting students' choices: "I would respect the decision of the students not to share the data." In addition, teachers agreed that data should not be permanently recorded and emphasized that the acceptability of data sharing depends largely on who receives the information: "I think it is not ok to record data permanently."

In summary, both students and teachers emphasized the importance of consent and open communication in data sharing. Students strongly desire transparency and control over their data, while teachers balance these concerns with the practical benefits of data sharing for educational support. Ultimately, both groups agree that a careful, transparent approach is essential to maintaining trust in AI-based learning systems.

Students Autonomy and Decision Making

The question of how much autonomy students should have in decision making highlights both the opportunities and challenges for students and teachers. Students expressed a desire for control, not only over the sharing of data, but also over their learning

path. Many students were uncertain about their self-assessment skills and questioned their own ability to make independent decisions. One student noted, "It is not a good idea to let me decide on my own," reflecting a broader lack of confidence agreed by others: "I don't trust my self-assessment," suggesting a need for balanced guidance in making learning decisions (e.g., such as choosing appropriate task to work on). Despite these concerns, students still want some degree of choice. "I want to be able to make choices," especially in selecting tasks. Another student reflects on the consequences of their decisions, admitting that "you [, the student,] regret your choice that you didn't do the homework [that was assigned to you] and didn't understand as good [as you will] wish that you did [...] more practise in." This sense of responsibility for their learning outcomes was further highlighted by a student who explained "Getting a bad grade because I made the wrong decision about learning content would motivate me to do better." These statements illustrate a sense of responsibility that students feel for their own academic performance and emphasize that they hold themselves, not their teachers or AI, accountable for their outcomes.

Teachers shared a more structured view of student autonomy, recognizing the need for a balance between giving students freedom and providing necessary guidance. Many teachers expressed concern about students' ability to accurately access their own learning needs ("Students are not good at assessing themselves"). One teacher mentioned that "[they] think it is very likely, that students do wrong content decisions on purpose or due to lack of assessment skills." These views reflect a general skepticism about students' ability to make independent decisions without support. On the other hand, some teachers see the potential for students to make informed choices: "Students are good at assessing themselves." Nevertheless, most teachers believe that the students' choices should be guided by teachers or AI: "Teachers should guide students decision making," and "AI should guide student decisions."

Moreover, some teachers advocate a balance between allowing student choice and

providing necessary guidance, but giving students some freedom: "My students should be able to choose on their own." Despite these differing views, teachers generally supported limited autonomy, particularly in the choice of tasks, while ensuring that students remained focused on educational goals. As one teacher noted that this could be achieved, by limiting students' choices ("Students should be limited in their choices") (e.g., by having a fixed set of required tasks and additional tasks). We found that opinions about student agency when it comes to data sharing ranged from students should not have any autonomy to determine what they want to share to students should be able to choose freely. However, most teachers agreed that "students' choices should be respected to help them perform well," reflecting a shared belief in the importance of respecting student agency within reasonable limits.

Both students and teachers agreed that student autonomy in decision making about data sharing and learning tasks should be encouraged, but with appropriate boundaries and guidance. Students wanted to be in control of their learning, particularly in selecting tasks and sharing data, while acknowledging the need for guidance to avoid poor decisions. Teachers, while supportive of giving students some autonomy, emphasized the importance of maintaining structure to effectively guide their decision-making. The consensus among both groups underscores the need for a balanced approach that encourages students autonomy while ensuring that educational goals are met.

Similarities and Differences Within the Four Agency Dimensions

Feedback & Help Agency

In examining the Feedback & Help Agency dimension, we found that both students and teachers have a nuanced understanding of the balance between student and AI control in the classroom, with neither group expressing a preference for either full student control or full AI control.

Students express mixed feelings about their autonomy over feedback and help. While they acknowledge the need for guidance to improve understanding, they often highlight the

challenges of getting timely help in the classroom. Many students express that they need help but find it difficult to get it in class ("It is hard to understand everything and get help in class"). Despite these difficulties, students generally appreciate receiving feedback directly from teachers, but are skeptical of AI systems that might monitor their performance without their knowledge or approval. They emphasize the importance of being notified when the AI shares their performance data with teachers and maintaining some control over this process, and stress that personal factors such as their learning pace can affect their performance ("I like to take my own time to understand, in class they go a bit too fast"). This reveals their concern about AI systems having too much control without sufficient transparency. On the other hand, some students see the potential for AI to enhance help-seeking in the classroom, noting that AI could extend and enrich teachers' personalized support. For example, AI's ability to notify teachers when a student needs help, combined with the student's problem area, could lead to tailored explanations that improve individual understanding ("through what the AI sends to the teacher, [the student] could get a special explanation from the teacher [...] and then understand how [they] can or should do it"). This reflects students' desire for a balanced integration of AI: taking advantage of its ability to assist teachers while maintaining transparency and student control.

Students also show different preferences in how they seek help. Some are comfortable asking for help verbally in class, while others prefer a more discreet approach, such as using AI to signal for help without attracting attention. This distinction highlights the different levels of comfort students have with interacting with teachers in the classroom. Using AI to ask for help can help weaker students or students who are afraid to ask for help ("I feel judged when I ask for help"). In summary, students see AI as having the potential to help ("AI can help me learn", "AI has the ability of help/guidance", and "AI makes my work easier and better"). In addition, students are skeptical of AI-generated hints, noting that some hints are unhelpful and may even be misused by students who rely on copying answers rather than

learning from the guidance provided ("I think copy-pasting is a smart and quick way to do homework, but you do not learn anything"). Thus, while students recognize the ability of AI to provide assistance, they also emphasize that such systems must be carefully designed to avoid encouraging unproductive behaviors. Moreover, some students feel that AI could provide more personalized support than their teachers, like a personal teacher, citing AI's neutrality and ability to focus on individual needs without having to divide attention across the classroom. This suggests that some students see potential for AI to play a complementary role to teachers, particularly in providing targeted feedback and support.

Teachers also recognize the importance of providing help and feedback to students. They emphasize the need for structured support and guidance and acknowledge the variability in how students seek help, noting that while some students accept help, others may resist it even when it is needed. Teachers believe that their own behavior influences students' willingness to ask for and accept help, highlighting the importance of student-teacher dynamics in shaping these interactions. Like students, teachers see the potential for AI to enhance their ability to provide support, particularly in identifying which students need help. They recognize the limitations of their ability to monitor all students at once, and appreciate AI's ability to alert them to problems that might otherwise go unnoticed. However, they are cautious about the potential negative effects of AI monitoring, noting that students may feel overly monitored or transparent, which could demotivate them and strain the teacher-student relationship ("Well, [the teacher] have to know from somewhere where or why [the student] is having problems here and that could of course also become a certain confidence problem, that [the student] feels more or less transparent and then has even less motivation to work on the tasks or blocks even more. That would also be a risk in the teacher-student interaction, which of course also affects [the teacher] personally").

In addition, teachers acknowledge that AI could potentially increase peer judgment, as students may notice when a teacher is focused on helping a particular individual, leading to

social discomfort ("I think weak students will feel uncomfortable by systems notifying me of problems, because peers will notice as well"). To mitigate this, teachers suggest strategies such as moving around the classroom regularly and engaging with all students, not just those who need help, to avoid singling out weaker students. While generally positive about the potential for AI to support help-seeking in the classroom, teachers stress that AI-generated hints should be designed to prevent students from simply copying answers. They also emphasize the importance of maintaining human communication, fearing that using AI-enhanced learning systems could diminish the social aspects of learning that are crucial in a classroom environment ("I feel like using such AI learning systems might lose human communication, which is very important in the classroom").

Data Agency

In the Data Agency dimension, we explored the control dynamics between students and AI in the context of managing personal data. Both students and teachers expressed strong opinions about who should have control over data collection, access, and sharing in educational contexts. While students tended to favor full learner control, emphasizing their autonomy in deciding when and what data to share with teachers, teachers were more hesitant to fully give control to students. They showed a greater preference for systems in which the AI had more control, ensuring that important data would be shared with them regardless of student preference. This divergence reflects different priorities: students seek autonomy and transparency, while teachers prioritize access to data for instructional purposes.

Students show a clear preference for maintaining control over their own data. They recognize the value of sharing data with teachers, especially for improving learning outcomes, but they also express concerns about privacy and consent (“I like AI support but the data need to be handled carefully”). Students emphasize the need for transparency in how their data is collected and shared, and express a desire to be in control of these processes ("Sharing

is fine as long as everyone agrees [consent]"). They express discomfort with the idea of full AI control over data, fearing that they may not be aware of when or how their information is shared ("I want to be in control of when my data is sent"). This concern is compounded by the potential for data to be accessed without their knowledge, with students emphasizing the importance of being informed when data is sent to teachers ("I would actually like to know if or when an AI system sends something about what I did to my teacher"). In addition, students express that privacy should vary by age, with younger students having less autonomy over their data ("It is okay for younger students to have fewer choices"). This shows that students are aware of the different levels of data literacy and maturity of different age groups.

Interestingly, while students value data transparency and control, they also highlight the potential downside of an over-focus on data, noting that constant access to performance metrics could reinforce a narrow self-definition and risk defining themselves, or being defined by others, solely by their data. They also mention thinking negatively about their grades ("Poor performances make me feel bad"). They are uncomfortable sharing data with peers because it could lead to embarrassment or judgment ("I feel embarrassed to be seen by my peers"). However, students generally agree that teachers should have access to their data if it is relevant to help the teacher, although this access should be limited to the subject the teacher teaches ("Teachers should only see data about their subject"). Some students are open to sharing data with parents, but stress the importance of limiting who has access and when.

Teachers' views on data agency reveal both shared concerns and divergent opinions compared to students. Like students, teachers emphasize the importance of transparency in data collection and sharing, stressing the need for open communication with students ("When it comes to collecting and sharing data, I think open communication is key"). Teachers believe that explaining the reasons for data collection helps to reduce student anxiety and build trust in the system ("I think it is important to communicate to students why the data is

collected"; "To address student's fear of making mistakes, open communication about data use is important"). However, teachers differ from students in their preference for control over data. Many teachers support a system where they have more authority over data sharing, arguing that they need full access to data in order to provide effective support ("I think it is needed that all data is shared"; "I would not use such a system if some students would not share their data").

Teachers are divided on whether students should be notified every time information is shared with them. Some believe students should always be informed ("The student must always be notified when information is shared"), while others believe that notification is not always necessary ("Not notifying students that the teacher has been notified is fine with me"). This difference reflects different attitudes toward student autonomy and transparency in the data-sharing process. Despite these differences, teachers share students' concerns about over-collection of data. They are skeptical about collecting data continuously and emphasize that data collection should be limited to relevant situations ("I think it is not okay to collect data all the time"). In addition, teachers express concern about the potential misuse of data, recognizing that while data can be a valuable tool, it must be handled carefully to avoid undermining trust ("Measurement data can be used for good, but it can also be misused"). Teachers also have strong opinions about the role of AI in student assessment. Some are open to the idea of AI assisting with assessment, while others believe that assessment should remain the responsibility of teachers alone. This divergence reflects broader concerns about the impact of AI in the classroom and the extent to which it should be involved in key pedagogical decisions. Like students, teachers agree that younger students should have less autonomy when it comes to sharing data, suggesting the need for age-appropriate guidelines for data management in educational settings ("I think younger students should have less autonomy about sharing data").

Orchestration Agency

When it comes to collaboration, we didn't find any major differences between full learner and full AI control in the student and teacher interviews, or between both groups. The preferences and views of students and teachers with regard to group work and collaboration reveal both similarities and differences.

Students have mixed feelings about group work and group formation, balancing the benefits of collaboration with their desire for autonomy in choosing peers. Some students value working with peers ("I like to ask for help from my peers"), while others express a preference for working independently ("Working alone is better than in a group"). When group work is necessary, they stress the importance of choosing group members carefully, believing that group composition plays a key role in their learning experience. Some students argue for working with peers of similar abilities ("My groupmates should be at my level"), while others recognize the value of diverse abilities in enhancing group performance ("Different abilities make a good group"). An interesting point is that students acknowledge AI's potential to form effective groups by using background learning data ("I think AI matches would be better than the teacher's ones"). However, they express concern that AI may miss important social dynamics, leading to uncomfortable groupings with peers they don't like or don't know well. As one student noted, "AI is not able to get social dynamics," explaining that while AI could make technically correct decisions, it lacks the nuanced understanding of human relationships. Students would therefore prefer to retain the ability to accept or reject AI's suggested groupings ("I would like to be able to refuse or accept AI's decisions"), emphasizing their need for some level of control. They also believe that teachers should retain the authority to override the AI's decisions if necessary ("My teacher should be able to change AI's decisions by AI if they see problems with it").

Teachers also recognize the value of peer collaboration, highlighting the effectiveness of students helping each other ("Helping among peers is very important and effective").

However, they acknowledge that not all students thrive in group settings and some prefer to work alone ("Some students prefer to work alone"). When it comes to grouping, teachers are divided: some advocate grouping students with mixed abilities ("I think weak students should be grouped with strong students"), while others believe that weaker students might benefit more from working with peers of similar abilities ("Weak students can help each other"). Teachers see the potential for AI to help orchestrate group work by selecting optimal group configurations based on student performance data ("It is good that AI helps me select the best group"). However, as well as the students, they are cautious about the limitations of AI, particularly its inability to account for social factors that significantly affect group dynamics ("AI is lacking important social aspects"). Teachers emphasize their responsibility to monitor group interactions to ensure that all students benefit from the collaborative process, suggesting that their involvement is essential to address the social challenges that AI may overlook. As one teacher explained, "As a teacher, I need to keep the social aspects in mind when working with AI." Teachers also expressed concern about relying too heavily on AI in the orchestration process, fearing that it could interfere with meaningful educational interventions. One teacher expressed this concern: "[By using this system], I am handing over learning to a certain extent... [which] may make meaningful educational interventions impaired or impossible."

Content Agency

When it comes to Content Agency, both students and teachers recognize the importance of personalizing learning content, but value full AI control over full learner control. We found that the two groups are pretty much on the same page when it comes to the amount of control students should have over their own learning paths.

Students express a strong desire for control over their learning content, emphasizing the benefits of personalized assignments tailored to their individual skills and interests ("I like the idea of getting homework tailored to me by AI"). They appreciate the concept of being

challenged by more difficult assignments ("I want to be challenged to do difficult work"), but they also value fairness and equity, believing that certain assignments should remain consistent for all students ("I think everyone should have the same mandatory exercises"). At the same time, students recognize the potential drawbacks if they have too much control over choosing which tasks they work at, admitting that if given a choice, they might choose easier assignments, resulting in a less fulfilling learning experience ("Students would choose easy [assignments] if [they] had a choice", "Choosing from many options would be a bad idea"). While they want to exercise choice, they also recognize that without guidance, they might prioritize convenience over growth ("I would like to choose what to do, but the teacher should guide it, otherwise I would just do the easy exercises"). On the other hand, we found that students are divided on whether AI should have the power to assign tasks. Some believe that AI's decisions could be insightful, using data to assign tasks better suited to their abilities than they could choose ("I think AI choice is good, it might know me better than myself"). Others worry that giving too much control to AI could take away students freedom and undermine their sense of autonomy ("If AI chooses for me, I am loosing my freedom of choice").

Teachers, like students, see value in personalized content. Many support the idea of personalized tasks being assigned by AI systems ("I think individualized tasks are good"). They also agree that giving students some choice can have a positive impact on motivation and engagement ("Students' choices should be respected to help them perform well"). However, they emphasize the need for balance and note that students may not always make the most challenging or beneficial choices ("Students will choose easy tasks if they do not want to work"). Therefore, teachers argue for limiting students' choices to ensure that they engage in tasks that promote learning ("Students should be limited in their choices"). They also point out that mandatory tasks should be in place to maintain consistency and fairness ("There should exist mandatory tasks"), reflecting concerns about inequities when students

have different tasks ("It often happens that students are complaining about others having different tasks"). Another concern raised by teachers is that personalized content could reduce peer collaboration and communication. When students are working on individualized tasks, there could be less opportunity for them to help each other and engage in collaborative learning experiences ("Communication might get lost with personalized exercises because students cannot help each other anymore"). Teachers also expressed a strong need to maintain control over AI systems, expressing the need to be able to add tasks to the AI's task pool or override the system's decisions when necessary ("It should be possible that I as a teacher can add more tasks to the AI's task pool", "I would like to always have control over the tasks the students have to work with").

Discussion

The purpose of this research is to investigate students' and teachers' perspectives on the integration of AI-enhanced ITSs in the classroom. To explore the similarities and differences in students' and teachers' perceptions of the use of such systems, the degree of control and student autonomy they prefer were investigated. The results revealed that both students and teachers generally view AI-enhanced ITSs as beneficial, particularly for providing feedback, identifying struggling students, and offering personalized learning experiences (Chiu et al., 2023). We found significant differences in how much control each group preferred to retain over decisions made by AI systems.

Across all dimensions of agency, students and teachers expressed a shared preference for hybrid control. AI systems should support human decision-making, not replace it, reinforcing the central role of teachers in shaping the learning environment (Akata et al., 2020; Echeverria et al., 2023; Herawati et al., 2024; Holstein et al., 2019a, 2020; Molenaar, 2022). Students are particularly concerned about privacy and prefer to retain control over personal data, especially when it comes to sharing emotional states or behavioural analysis. They expressed discomfort with AI systems that automatically share sensitive information

with teachers, preferring instead systems that allow them to selectively share data. This was particularly evident in the Feedback & Help and Data Agency dimensions, where students wanted to determine when and how their personal data was shared.

Teachers, on the other hand, were more focused on maintaining control over pedagogical decisions and classroom management. While they recognised the potential for AI to improve teaching by automating certain tasks, such as providing real-time feedback or identifying students who need help, they were keen to maintain their role as critical facilitators whose professional judgement should guide how AI-generated insights are applied. In the Orchestration and Content Agency dimensions, teachers expressed a preference for AI to assist in organising lessons and grouping students, but not to dictate these decisions entirely. They felt that their expertise was critical in interpreting AI data in the context of their students' needs and curriculum goals.

Moreover, the study revealed both alignment and divergence in students and teachers view on student agency. One point of convergence was the shared belief that AI should act as a supportive tool rather than taking over educational responsibilities. Both students and teachers valued AI's ability to enhance learning, but emphasised that human interaction should remain central to the educational process. However, this common ground diverged when it came to issues of trust and control. Students placed a higher value on their autonomy and were wary of AI systems that might invade their privacy. This was particularly evident in their reluctance to engage with systems that continuously monitored and shared their emotional states or other sensitive data with teachers.

Teachers, on the other hand, were concerned that without access to this kind of data, they might miss important opportunities to intervene and support students. They argued that AI systems need to strike a balance between protecting student privacy and providing teachers with enough information to make informed decisions. For example, in the Feedback & Help and Data Agency dimensions, teachers emphasised the importance of being able to

access performance data and behavioural trends to effectively support students, while students emphasised the need for greater control over what data is shared.

In addition, we have identified a number of key findings that have an impact and influence across all dimensions of agency. First, teachers recognized that fostering a supportive, trusting classroom environment is essential for students to feel comfortable using AI tools. Without such an environment, students may be reluctant to engage with AI systems due to fears of data misuse or concerns that AI will undermine the human elements of education, such as personal interactions with teachers and peers (Idroes et al., 2023; Nye, 2014). The findings underscore that teachers play a critical role not only in teaching academic content, but also in managing the socio-emotional climate of the classroom. They need to ensure that AI is used in ways that enhance rather than detract from the social and collaborative aspects of learning, such as group work and varied teaching styles. Teachers argue that an over-reliance on AI could reduce the richness of classroom interactions, and therefore advocate a variety of teaching methods that incorporate both AI and more traditional pedagogical approaches.

Second, the study also reveals the importance of the student-teacher relationship in influencing student acceptance of AI. Students' willingness to accept AI-generated feedback, group work assignments, or study task recommendations was closely tied to their sense of trust in their teachers. Teachers understood this and emphasized that successful AI integration requires open communication and the cultivation of a trusting learning environment. Students mentioned that, depending on the relationship to the teacher, they are less likely to engage meaningfully with AI tools, particularly due to privacy concerns or misinterpretation of AI-generated recommendations. This finding suggests that the success of AI in the classroom depends not only on the technology itself (Marrone et al., 2022; Sumakul et al., 2022), but also on the interpersonal dynamics between students and teachers.

Another important point to add is that students and teachers expressed concern that

AI could lead to an unhealthy classroom environment by focusing too much on performance and reducing social interactions. Teachers see themselves as responsible for maintaining a balanced classroom climate, ensuring that communication remains central, providing help and feedback, and incorporating non-digital group work, even when AI is involved in grouping. To avoid over-reliance on AI, teachers stress the importance of varying teaching styles, alternating between direct instruction, group work, and individual activities using various media sources.

Teachers stressed that distrust and fear of AI can lead to negative classroom dynamics. This is supported by research showing that negative attitudes toward AI can significantly impact perceptions of AI (Chiu et al., 2023; Idroes et al., 2023; Nye, 2014). This reveals that effective AI integration in education must go beyond simply implementing AI systems; it requires thoughtful design that fosters trust, maintains a healthy classroom climate, and supports diverse teaching methods. Teachers play a critical role in maintaining balance, ensuring that AI does not dominate the learning environment or focus solely on achievement. Instead, AI should be used as a complementary tool that supports teachers' professional judgment and promotes a holistic learning experience that includes social interactions, collaboration, and varied teaching strategies. Open communication and transparency are essential to reducing distrust of AI and creating an environment where AI is seen as a supportive resource rather than a threat to autonomy or privacy. This underscores the need for both practical teacher preparation and nuanced approaches to using AI in the classroom to ensure that technology enhances learning without undermining the social and human aspects of education.

Focusing on teacher, the findings underscore the urgent need for comprehensive teacher training on the effective integration of AI systems. Throughout the interviews, we found that many teachers lack knowledge about how AI works and how it can be meaningfully applied to education. This gap in understanding has a direct impact on the

effectiveness of AI in the classroom (X. Chen et al., 2022; Nye, 2014). The lack of knowledge leaves teachers feeling unprepared to incorporate AI-enhanced systems, resulting in missed opportunities to improve instruction and student support. To realize the potential benefits of AI, teachers must be equipped with the skills and knowledge to use these tools in ways that enhance learning while maintaining their pedagogical influence.

In addition, as noted in previous studies (Holstein et al., 2017, 2019a), teachers expressed a need for qualitative data, not just quantitative insights; they expressed a need to know not just what, but why something is happening in the classroom. This desire for deeper understanding requires AI systems that can provide actionable, summarized information that teachers can use to make informed decisions.

Focusing on students, by recognising and addressing the multi-dimensional nature of student agency in AI-supported environments, systems can be designed to better support learners, enabling them to navigate and benefit from the autonomy provided (Bodily & Verbert, 2017; Damgaard & Nielsen, 2018). For students, the desire for autonomy was clear, but it also revealed a tension. While students valued the personalised support provided by AI, they were unwilling to relinquish control to the technology, particularly with regard to data sharing and learning decisions. Of particular interest is the desire to make independent decisions, alongside the awareness that students need help and support. Interestingly, we found that they reject both the full student scenario and the full AI scenario. What we found is that they are willing to give up some of their control if they think it will benefit their learning. This shows that it is not a question of whether students want to be in control or not. It is about a much more nuanced understanding of it. These findings highlight the need for practical design research that analyses rules, regulations and guidelines to support the necessary student autonomy in the use of AI in education. As student agency continues to evolve with the development of AI technologies, it is critical to develop models that not only promote independence, but also ensure that students are adequately supported to engage in

intentional, meaningful learning actions across multiple dimensions of their educational experiences.

Limitations and Future Work

In summary, the present work provides deep insights into the preferences, worries, and needs revealed by students and teachers to develop AI-supported classrooms. The relatively small sample size of 16 students and 15 teachers may not fully represent the broader population of students and educators, particularly across different regions or educational systems. A larger sample would be needed to gain a more complete understanding of the diversity of views. Moreover, students were drawn from a specific educational context (secondary school) and may not represent the experiences or perspectives of students in e.g., primary schools. The findings may therefore be difficult to generalize to other age groups or educational levels, where the dynamics of AI integration and student autonomy may be different. Another important point is that most of the students who participated in the study were at least bilingual. While this may enrich the data with different perspectives, it also introduces a potential bias as the sample does not reflect the average student population in Germany, particularly in areas such as communication and adaptability to new technologies such as AI.

The possibility of the Hawthorne effect (i.e., participants changing their behavior because they know they are being observed) may have influenced the data collection in the interview process. Students and teachers may have changed their answers or behaviors in ways they thought would be more favorable to the researchers, which could limit the authenticity of the responses.

Additionally, the study relied on hypothetical scenarios of AI integration that may not fully capture the realities of everyday classroom experiences. While these scenarios helped to provide useful insights into perceptions and attitudes, they may not reflect the actual complexities that teachers and students face when interacting with AI-enhanced systems in

real-world settings. The findings of this study are context-specific to the particular school system and technological infrastructure available in Germany. They may not be directly applicable to educational settings with different resources, policies, or cultural approaches to technology integration. This adds to the small amount of research in the field of AIED in Germany and can provide a basis for further research.

Future AIED research should further investigate how AI can be designed to support and improve rather than replace student decision-making and autonomy. This involves analyzing how AI systems can be calibrated to provide feedback and recommendations while allowing students the flexibility to make their own choices (Holstein et al., 2019a). Studies could explore different AI design strategies that enhance student autonomy while still offering valuable insights and support. Furthermore, further research could examine the long-term effects of AI on classroom dynamics in Germany, particularly with regard to social interactions and the potential overemphasis on achievement. This could include longitudinal studies that track how AI affects student-teacher relationships, student collaboration, and the overall classroom atmosphere. Future research could also focus on gaining a deeper understanding of how the student-teacher relationship impacts the classroom environment when interacting with AI-enhanced systems. The goal would be to create AI tools that foster and enhance this relationship, rather than weaken it by making students feel monitored or worried about data misuse. Another potential area for future research is the development of AI systems that provide teachers with more meaningful qualitative data. Studies could explore how AI can help teachers better understand not only what is happening in the classroom, but why, and how this deeper insight can be used to make informed decisions that improve the learning experience without over-relying on quantitative performance metrics.

Conclusion

The findings of this study highlight the need for a balanced approach to integrating AI-based learning systems into the classroom to enhance student agency. They converge on a

central theme: while AI offers significant potential to support learning, its effectiveness depends largely on the behavior and role of the teacher. Teachers act as critical facilitators between students and AI, shaping how students perceive, interact with, and accept AI tools in their educational experience. Therefore, it is essential to support a balanced, thoughtful approach to AI integration, one that respects the roles of both teachers and students, in order to create a learning environment where technology enhances, rather than hinders, the educational experience. The future of AI in education is not to replace the humans, but to augment them, creating a harmonious blend of technology and human interaction that empowers students and supports effective teaching.

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List of Abbreviations

ITSs Intelligent Tutoring Systems

AD Affinity Diagramming

AIED Artificial Intelligence in Education

Appendix A

Interview Protocol

Figure A1

Student Interview Protocol

Interview protocol

Hello, I am *name*, I am a student at the University of Saarland, nice to meet you.

Thank you for agreeing on being interviewed today. We are going to talk about your school experience, especially regarding the use of technology and AI during class. Please **feel free to interrupt me** at any time for any questions, or doubts or if you want to stop the interview or take a break. I am going to take some notes to not forget the things we'll talk about, but do not worry, **there is no such thing as a right or wrong answer**. The interview will last about **30 minutes**. I already gave your parents a **consent form**, which all of you approved and that they signed, that gives me permission to record this talk and to use the data for our research. The data will not be used outside of this scope. As agreed in the form, you will receive 12 euros after this session.

If group interview: please feel free to **express what you think**, so it is totally fine if you have two **different opinions**. Not only, it would be even more interesting! It is completely okay to think different things, there is no right or wrong idea

If you don't have a question and if it is okay for you, we can start.

- How old are you? What grade are you in?

First, I would like to know a bit about your experience in school *[Goal: Get to know student & first preferences]*

- What do you like about the typical math class you have and what do you not like?
    i. Do you like how your teacher is doing it?
    ii. What activities are you doing?
    iii. Is your teacher using any kind of technology in class? How do you feel about it?
- How do you feel when you get to choose what to do in class e.g. if you would get a free study phase? *[Goal: Introduction to agency in general & opinion on control by student]*
- How does your teacher provide feedback to you usually? How often do you get it? What do you do when you disagree with them? *[Goal: Identifying current problems with feedback, e.g. amount, of student]*
- What do you do when you don't understand something in class? And at home? *[Goal: Identifying current situation, problems & struggles on learning of student]*

Thank you so much, that is very interesting! Now I would like to talk with you about some AI that can be used in the classroom. This technology would be like a digital tutor, able to identify how you feel, when and why you are struggling, basically adapting to your needs.

- Have you ever used an AI tool? Even outside of school! If yes, for what? Can you tell me a little bit about it? *[in case the student is not sure provide ChatGPT as example since that is most common one]*
  [Goal: Identifying knowledge on AI to understand next answers. Gives answer to the question: "Is the biggest problem that they do not know what AI exactly does?"] (MAKE EXAMPLES: ChatGPT, DALL.E, AUTOCOMPLETE…)
    i. How do you feel when you think about AI and what it can and cannot do?
- How do you think an AI could be used in school? What could be some pros and cons?

Good! Now I'll show you some comics, that talk about some kind of situation. It will be like a little game, I'll give you a short time to look at them. Speak your thoughts with no fear or worry and let me know what you think. If it's all clear, then we can start!

[present scenarios, one at a time, 1 minute each] *[Goal: Developing the "perfect agencies" with the student by giving extreme cases]*

- For each scenario: on a scale from 1 (I would hate this) to 5 (I would love this), how would you rate this situation?

Possible questions to keep up talking:

a. How does it make you feel that your teacher can see your data on the tool?
b. How do you feel about a computer program, which is based on AI, to make decisions about what you should learn?
c. Do you see any benefits in using AI?
d. Do you have any concerns about AI?
e. Do you think that teachers should have access to data collected by the AI? Why or why not?
f. How does your math teacher give you tasks? Do you have to do all of them? Are they of different difficulty?
g. If you had the power to choose what topic to practice in math. What would it be? Why?
h. What would learning different if AI would be able would give you feedback? How would you feel about it?
i. Do you think it's important to have the option to work alone or in a group? How would you feel if AI decides for you if you should work in a group or alone? Even the participants?

Okay, thank you so much for all your interesting insights! I have no further questions for you other than if you would you like to add any comment: What did you think about the topics we talked about?

Thank you once again for your time, if you would like, we will keep you updated on our results once we have them. It was very nice talking with you today!

Figure A2

Teacher Interview Protocol

Interview protocol

Hello, I am *name*, [short description about what I'm studying] and this is my colleague *name*, [short description about what the colleague is studying] and will be supporting me today.

Thank you for participating in the interview today. We very much appreciate your participation, and we would like to hear about your experiences as a teacher, especially on the use of technology and AI in the classroom. Please **feel free to interrupt me** at any time for any questions, concerns, or if you want to stop the interview or take a break. I will be looking at a document from time to time and may also take some notes to help me remember the things we are talking about. Please know that **there is no such thing as a right or wrong answer**. We want to hear your opinion and your thoughts on the subject!

The interview will last about **60-80 minutes**. [Check if Consent Form is signed!] As you already indicated in the consent form, we would like to record this session. Once the study is completed, you will receive 40€ 40€ via bank transfer to the account provided.

If group interview: please feel free to **express what you think**, so it is totally fine if you have two **different opinions**. Not only, it would be even more interesting! It is completely okay to think different things, there is no right or wrong idea.

Do you have any questions before we begin? If not, I would like to start by asking some general questions about your teaching start.

----This section below should go quickly, and but important to start developing a comfortable environment--

- How many years have you been teaching?
- Which grade levels do you teach?
- In which form of school are you teaching?
- What subjects do you teach?
- (If applicable: In which state are you teaching? (e.g. Saarland, Bavaria …))

----Main interview questions---

Next, I would like to know more about your teaching, especially about the use of technology *[Goal: Get to know the teacher & initial preferences]*

- Do you use (or have you used) any kind of technology in class to support student learning?
    i. What kind?
    ii. If so, how often?
    iii. What do you like about those specific tools? What do you not like about them?
- Have you used any AI-based learning technologies in the classroom?
    i. If yes, what ones?
    ii. What can you imagine AI-based learning technologies could do to help your teaching and student learning?
    iii. (Or how do you think AI-based learning technologies be useful for your teaching and student learning?)
    iv. What kinds of issues do you think AI-based learning technology might cause?

Thank you very much for sharing your thoughts. In this session, when we say “AI-based learning technology” we often refer to intelligent, personalized learning systems that provide feedback, assignments, scaffolding, and assistants based on AI-detected information about student learning. [Mention an example– in DE, “bettermarks”? in Japan, “Qubena”?]. Therefore, we would not include any generative AI tools such as ChatGPT.

- [Optional]: Did you take any further training in the past, especially regarding digital tools?)
    i. If so, how often?
    ii. Were you able to apply taught methods for your classes?
    iii. How did students respond to those methods?

That sounds interesting! Now I’ll show you some comics that depict certain situations. I’ll give you a short time to look at them. Afterwards, please share your thoughts with us and tell us what you think about the situation and how you could imagine using it. Then we will show you possible outcomes of the situation, which you will have to evaluate at the end. We go through each of these 8 scenarios step by step.

Do you have any questions? Then let us look at the first one.

[present scenarios (in a random order), one at a time, 1 minute each *[Goal: Developing the “perfect agencies” with the teachers by giving extreme cases]* and ask them to share their thoughts]

First think aloud about the scenario, [first 3 scenes] and imagine possible outcomes

- How would you make use of this in your real classroom setting?
    i. Would it work?
    ii. How much would you interfere?
    iii. What are potential problems in your real classroom setting?

Now we show you outcomes we thought of you can think aloud and tell us what you think about those. Is it realistic?

- For each HYPOTHETICAL outcome of scenario: on a scale from 1 (I would not like to have this) to 5 (I would like to have this) happening in your class, how would you rate this situation?

[Go through the former formulated steps for each of the 8 scenarios]

Possible questions to keep up talking:

a. How does it make you feel that you can see the students data on the tool? / How do you think it make the students feel that you can see their data on the tool?
b. How do you feel about a computer program, which is based on AI, to make decisions about what your students should learn?
c. Do you see any benefits in using AI?
d. Do you have any concerns about AI?
e. Do you think that you or the students should have access to data collected by the AI? Why or why not?
f. How do you give your students tasks? Do they have to do all of them? Are they of different difficulty?
g. What would be different if AI would be able to give your students feedback? How would you feel about it? How do you currently give feedback to your students?

h. Do you think it's important to have the option to work alone or in a group? How would you feel if AI decides for you if you should work in a group or alone? Even the participants? How often do you do groupwork normally in your classroom?

Okay, thank you so much for all your interesting insights!

- What do you think about the topics we talked about today? Would you use such an AI-based system in your classroom? Why or why not?
- Do you have any further questions or thoughts that you would like to share with us?

I have no further questions for you other than if you would you like to add any comment.

Thank you once again for your time, if you are interested, we would be happy to keep you informed about our study and contact you for future study options at our department?

[Ask about willingness to participate to future studies if they said no in the Consent Form]

- Would you be willing to be contacted for other future study opportunities in our lab? If you agree, we may contact you for some other paid study participation opportunities.
- [If already agreed]: Thank you for your consent to be contacted for future study opportunities in our lab.

It was very nice talking with you today!

Appendix B

Statement of the Ethical Review Board

Prof. Antonio Krüger · Univ. des Saarlandes · Campus D3 2 · D-66123 Saarbrücken

UNIVERSITÄT DES

Prof. Dr. Antonio Krüger
Chair
Ethical Review Board
Department of Computer Sciences

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krueger@cs.uni-sb.de

Saarbrücken, 26.02.2024

Statement of the Ethical Review Board (ERB)
in response to your application (No. 24-02-3)

Dear Prof. Tomohiro Nagashima,

the ERB has reviewed your research project “Exploring pupils’ and teachers’ understanding of learning with AI in the classroom: Design studies in Germany”. According to its regulations, approved by the Department of Computer Science of Saarland University on October 26, 2016, the ERB has come to the following conclusion:

“There are no ethical concerns against the implementation of the research project, if the following requirements are fulfilled:

1. The prototype details (as provided via email) are included in the project description.
2. The information on how the studies will be adapted to different age groups (as provided via email) is included in the project description and the age range of Grade 1 to Grade 12 students in Germany is specified.
3. The details regarding the presence of an accompanying adult during the experiments (as provided via email) are clarified in the project description. It is advised that for younger children an accompanying/familiar adult (e.g. parent or teacher) remains with them or available in the same room throughout the experiment and not only at the beginning.”

If you have any questions, please let me know. We wish you all the best in your future research endeavours.

Best regards, on behalf of the ERB

Prof. Dr. Antonio Krüger
Chair of the Ethical Review Board
of the Department of Computer Sciences at Saarland University

Appendix C

Guiding Questions for Semi-Structured Interview

Table C1

Summary of interview questions for the semi-structured interview

Theme	Students Interview	Teachers Interview	Goal
Current classroom environment	How old are you? What grade are you in?	How many years have you been teaching?	Get to know the participants and their preferences
		What grades do you teach?	
	What do you like about the typical math class you have and what do you not like?	What type of school do you teach at?	
		What subjects do you teach?	
	i. Do you like how your teacher is doing it?	In which federal state do you teach?	
	ii. What activities are you doing?	Do you use (or have you ever used) some form of technology in the classroom to support the learning of your students?	
	iii. Is your teacher using any kind of technology in class? How do you feel about it?	i. What kind of technology?	
		ii. If yes, how often?	
		iii. What do you like about these tools?	
	How do you feel when you get to choose what to do in class e.g. if you would get a free study phase?		Introduction into agency in general
	How does your teacher provide feedback to you usually?		
	i. How often do you get it?		Identifying current situation and challenges
	ii. What do you do when you disagree with them?		
	What do you do when you don't understand something in class? And at home?		
AI Literacy	Have you ever used an AI tool? Can you tell me a little bit about it?		Identifying knowledge on AI to understand how they would interpret the scenarios
	i. How do you feel when you think about what it can and cannot do?		
	How do you think an AI could be used in school?		
	i. What could be some pros and cons?		

Appendix D

Guiding Questions for Scenario-Based Speed Dating

Table D1

Guiding Questions for speed dating

Students Interview	Teachers Interview
How does it make you feel that your teacher can see your data on the tool?	How does it make you feel that you can see the students data on the tool? /How do you think it make the students feel that you can see their data on the tool?
How do you feel about a computer program, which is based on AI, to make decisions about what you should learn?	How do you feel about a computer program, which is based on AI, to make decisions about what your students should learn?
Do you have any concerns about AI?	Do you see any benefits in using AI?
Do you see any benefits in using AI?	Do you have any concerns about AI?
Do you think that teachers should have access to data collected by the AI? Why or why not?	Do you think that you or the students should have access to data collected by the AI? Why or why not?
How does your math teacher give you tasks? Do you have to do all of them? Are they of different difficulty?	How do you give your students tasks? Do they have to do all of them? Are they of different difficulty?
If you had the power to choose what topic to practice in math. What would it be? Why?	What would be different if AI would be able to give your students feedback? How would you feel about it? How do you currently give feedback to your students?
What would learning different if AI would be able would give you feedback? How would you feel about it?	Do you think it's important to have the option to work alone or in a group? How would you feel if AI decides for you if you should work in a group or alone? How often do you do groupwork normally in your classroom?
Do you think it's important to have the option to work alone or in a group? How would you feel if AI decides for you if you should work in a group or alone? Even the participants?	

Appendix E

A section of the affinity diagram, illustrating key quotes organized by low-level themes

Figure E1

Example student low-level theme

Figure E2

Example teacher low-level theme

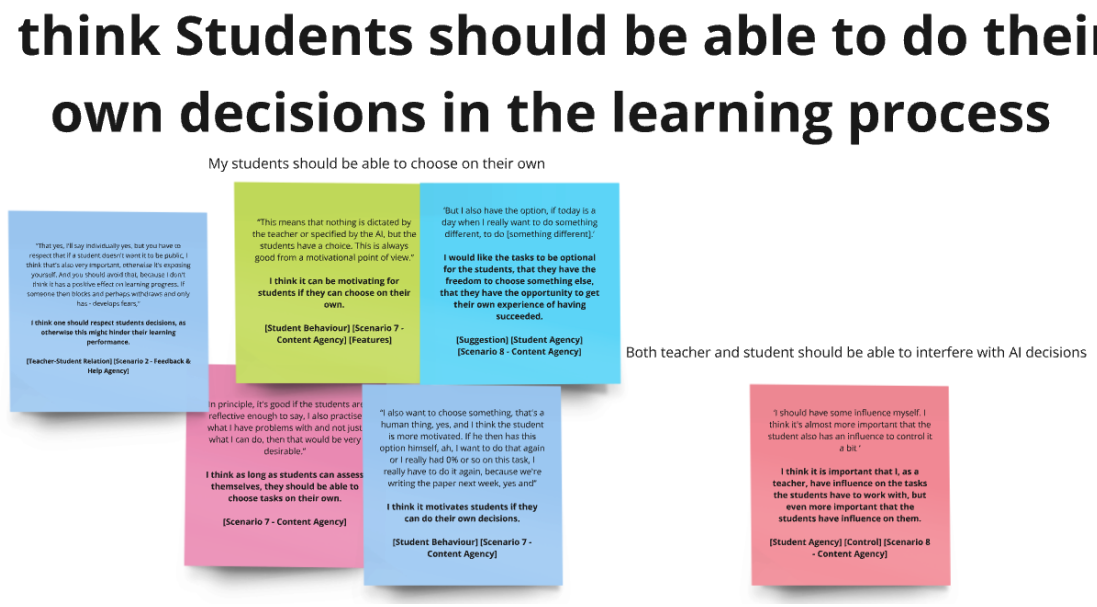
Appendix F

A section of the affinity diagram, illustrating key quotes organized by mid-level themes

Figure F1

Example student mid-level theme

Figure F2
Example teacher mid-level theme



Appendix G

A section of the affinity diagram, illustrating key quotes organized by high-level themes

Figure G1

Example student high-level theme

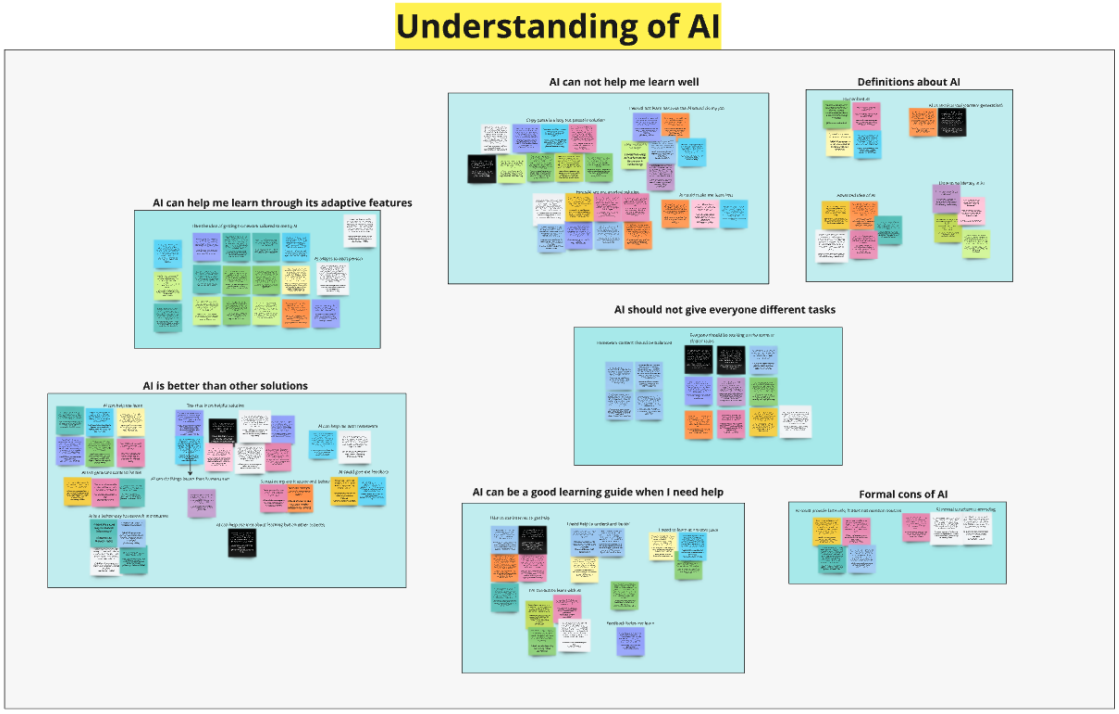
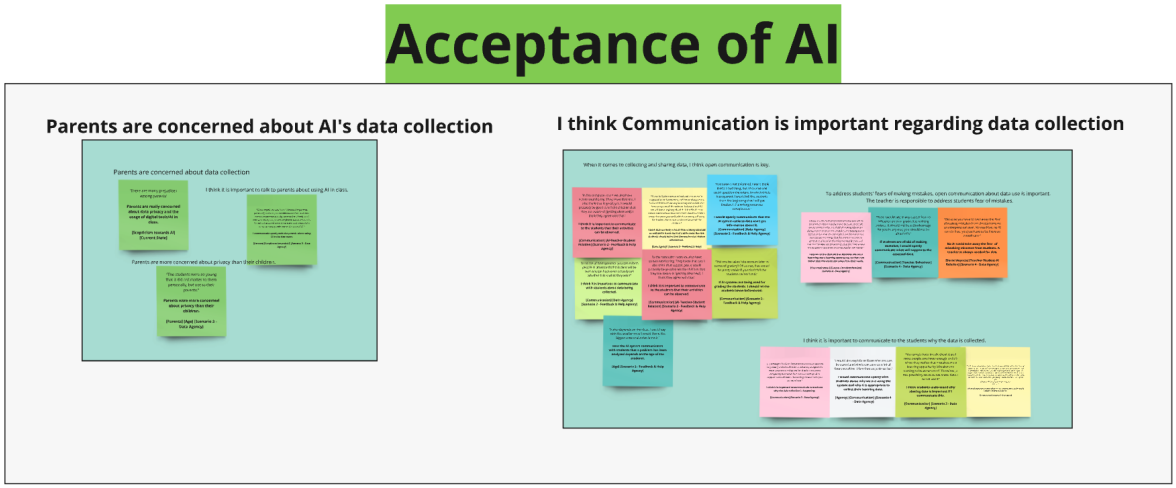


Figure G2

Example teacher high-level theme



Appendix H

Student Scenarios

Figure H1

Student Scenario 1: Full learner control over getting feedback and help

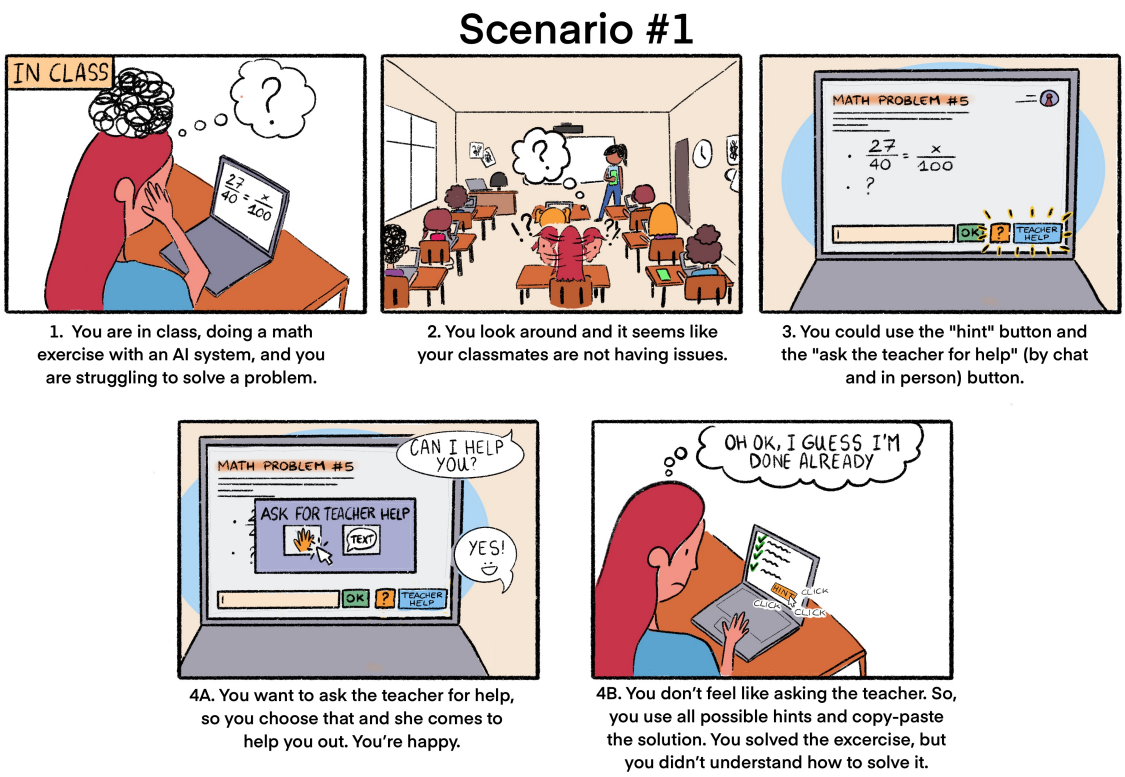
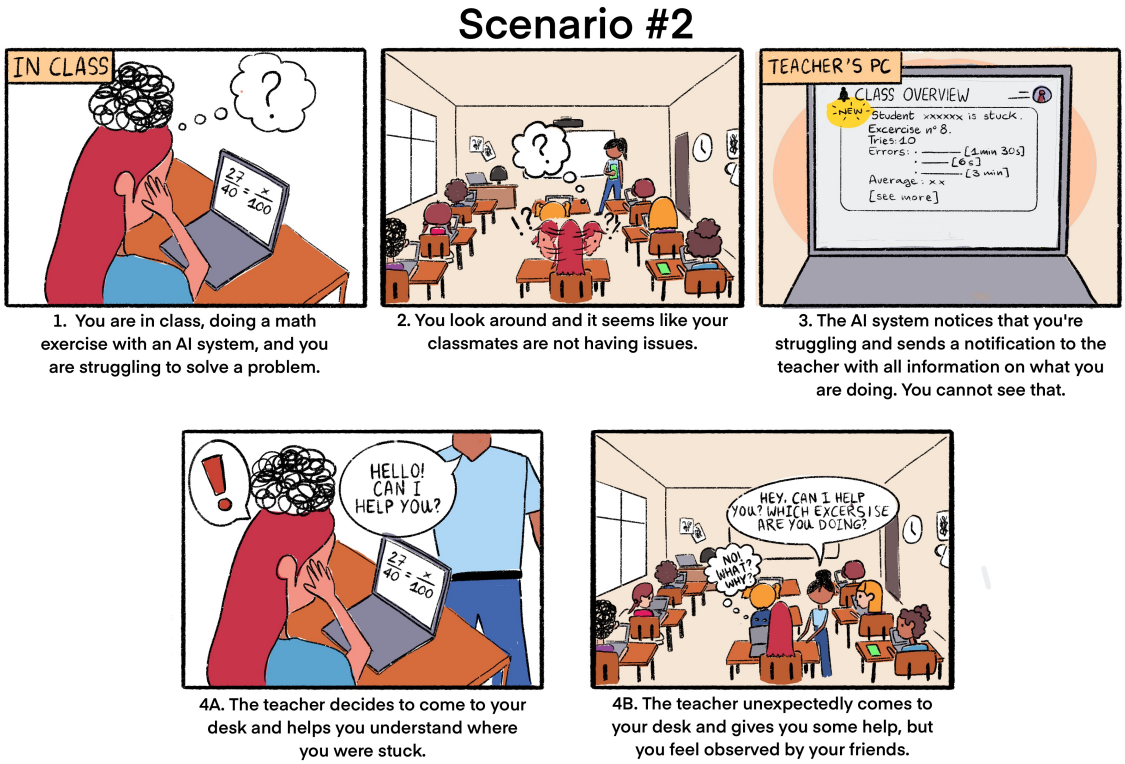


Figure H2

Student Scenario 2: Full AI control over getting feedback and help



1. You are in class, doing a math exercise with an AI system, and you are struggling to solve a problem.

2. You look around and it seems like your classmates are not having issues.

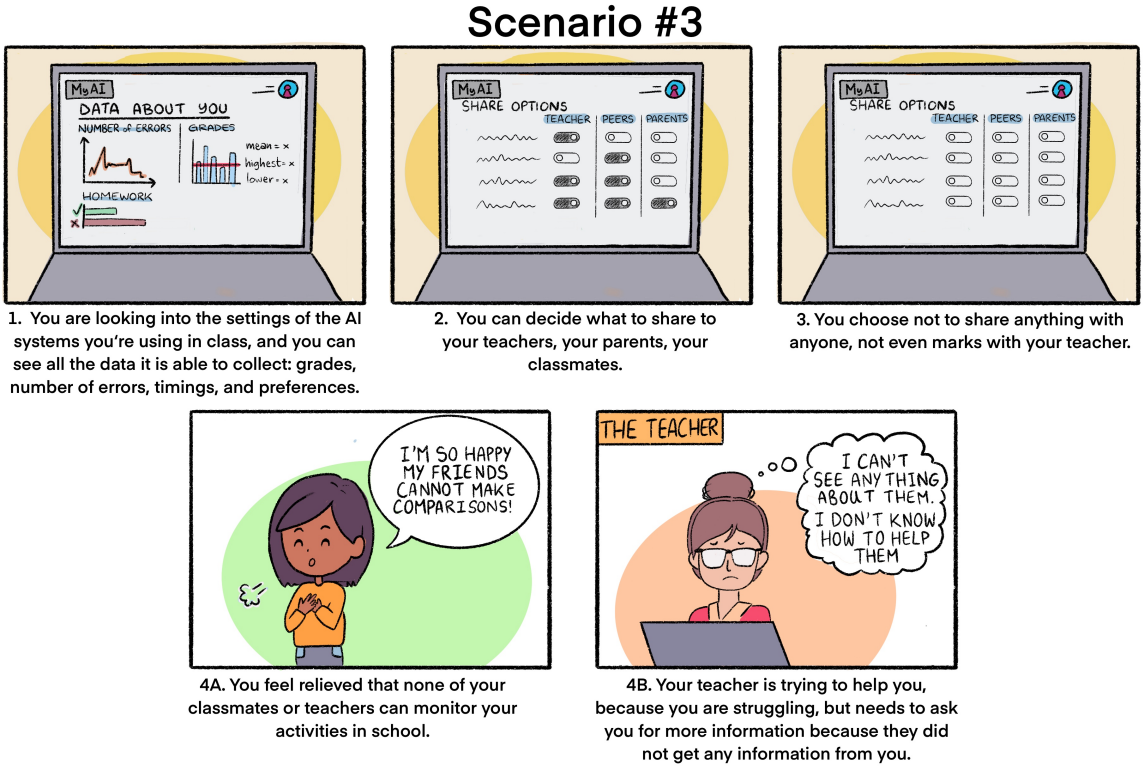
3. The AI system notices that you're struggling and sends a notification to the teacher with all information on what you are doing. You cannot see that.

4A. The teacher decides to come to your desk and helps you understand where you were stuck.

4B. The teacher unexpectedly comes to your desk and gives you some help, but you feel observed by your friends.

Figure H3

Student Scenario 3: Full learner control over data sharing



1. You are looking into the settings of the AI systems you're using in class, and you can see all the data it is able to collect: grades, number of errors, timings, and preferences.

2. You can decide what to share to your teachers, your parents, your classmates.

3. You choose not to share anything with anyone, not even marks with your teacher.

4A. You feel relieved that none of your classmates or teachers can monitor your activities in school.

4B. Your teacher is trying to help you, because you are struggling, but needs to ask you for more information because they did not get any information from you.

Figure H4

Student Scenario 4: Full AI control over data sharing

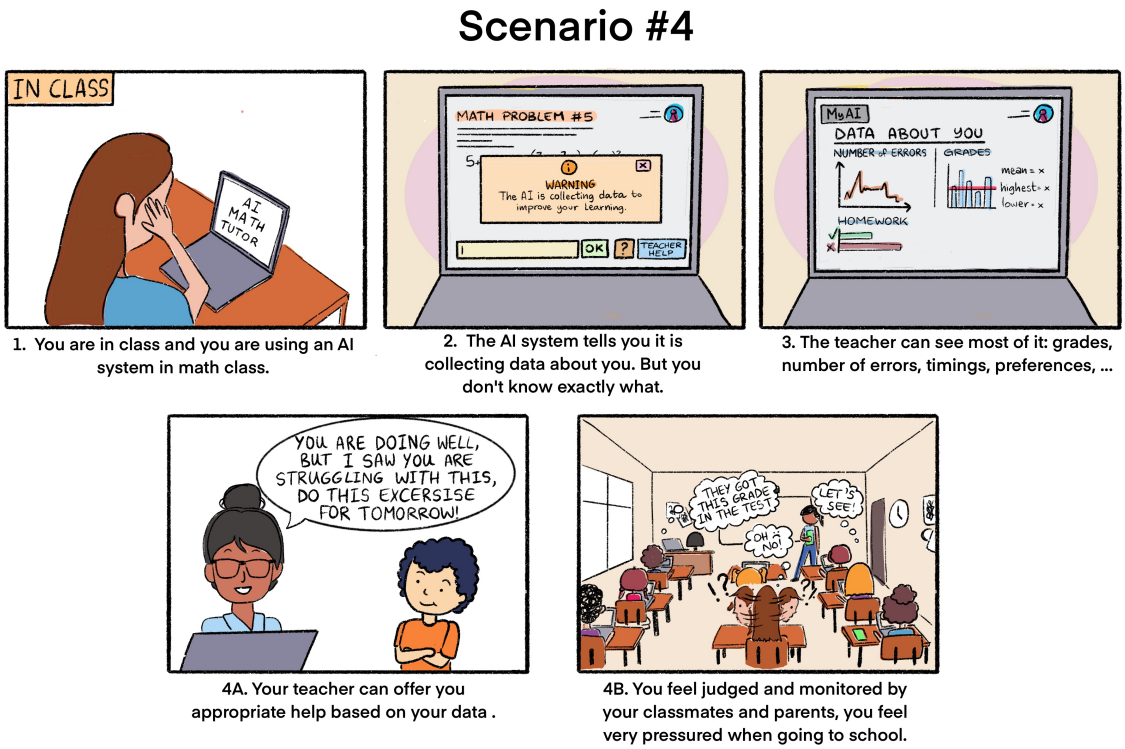


Figure H5

Student Scenario 5: Full learner control of classroom orchestration

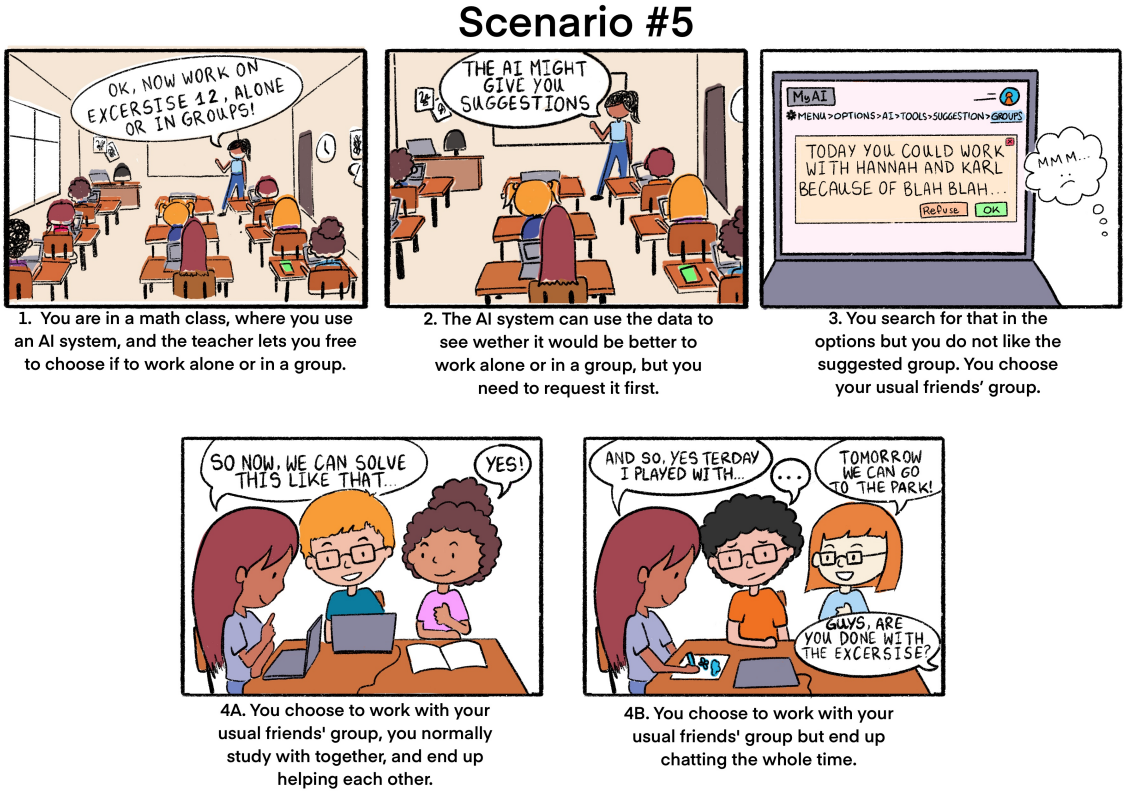
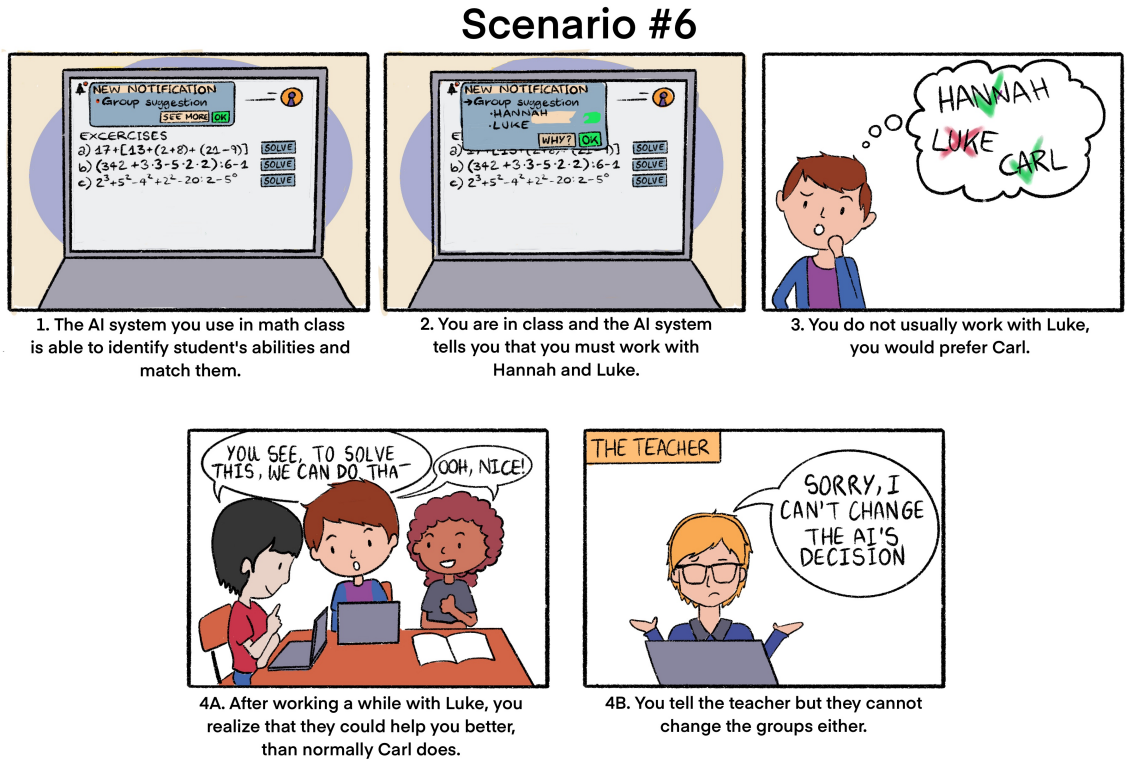


Figure H6

Student Scenario 6: Full AI control of classroom orchestration



1. The AI system you use in math class is able to identify student's abilities and match them.

2. You are in class and the AI system tells you that you must work with Hannah and Luke.

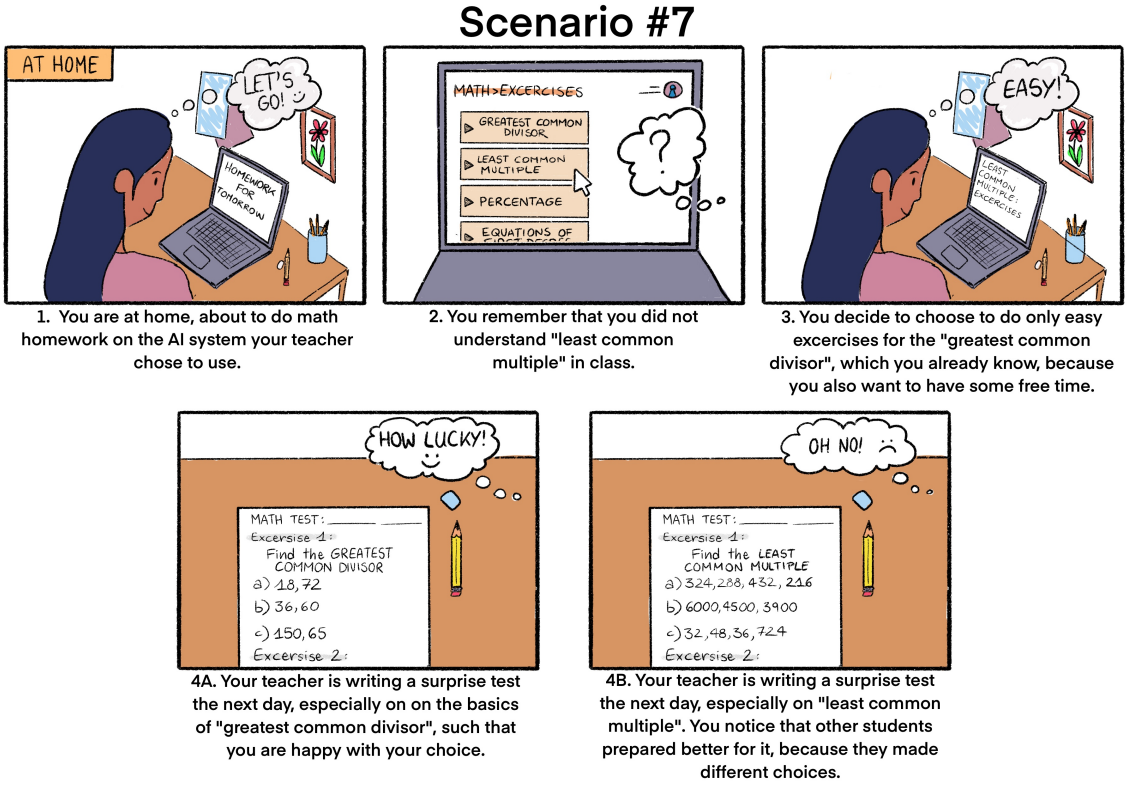
3. You do not usually work with Luke, you would prefer Carl.

4A. After working a while with Luke, you realize that they could help you better, than normally Carl does.

4B. You tell the teacher but they cannot change the groups either.

Figure H7

Student Scenario 7: Full learner control over educational content



1. You are at home, about to do math homework on the AI system your teacher chose to use.

2. You remember that you did not understand "least common multiple" in class.

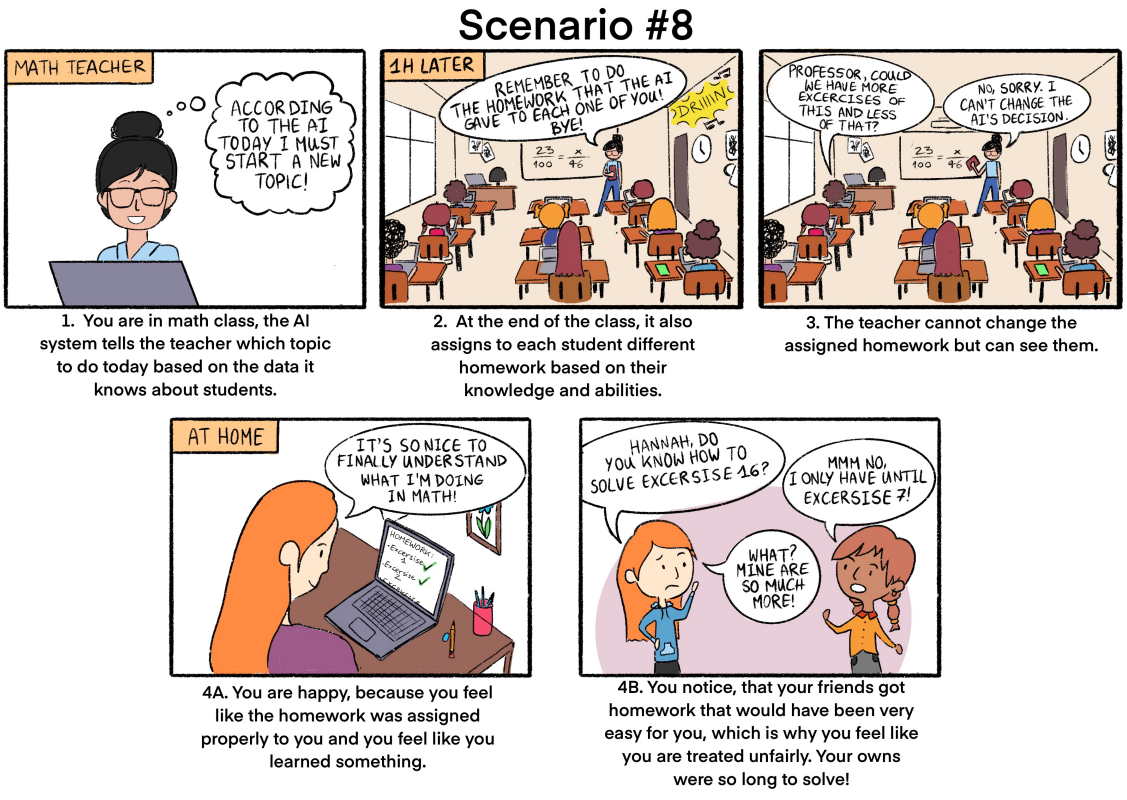
3. You decide to choose to do only easy excercises for the "greatest common divisor", which you already know, because you also want to have some free time.

4A. Your teacher is writing a surprise test the next day, especially on on the basics of "greatest common divisor", such that you are happy with your choice.

4B. Your teacher is writing a surprise test the next day, especially on "least common multiple". You notice that other students prepared better for it, because they made different choices.

Figure H8

Student Scenario 8: Full AI control over educational content



Appendix I

Teacher Scenarios

Figure I1

Teacher Scenario 1: Full learner control over getting feedback and help

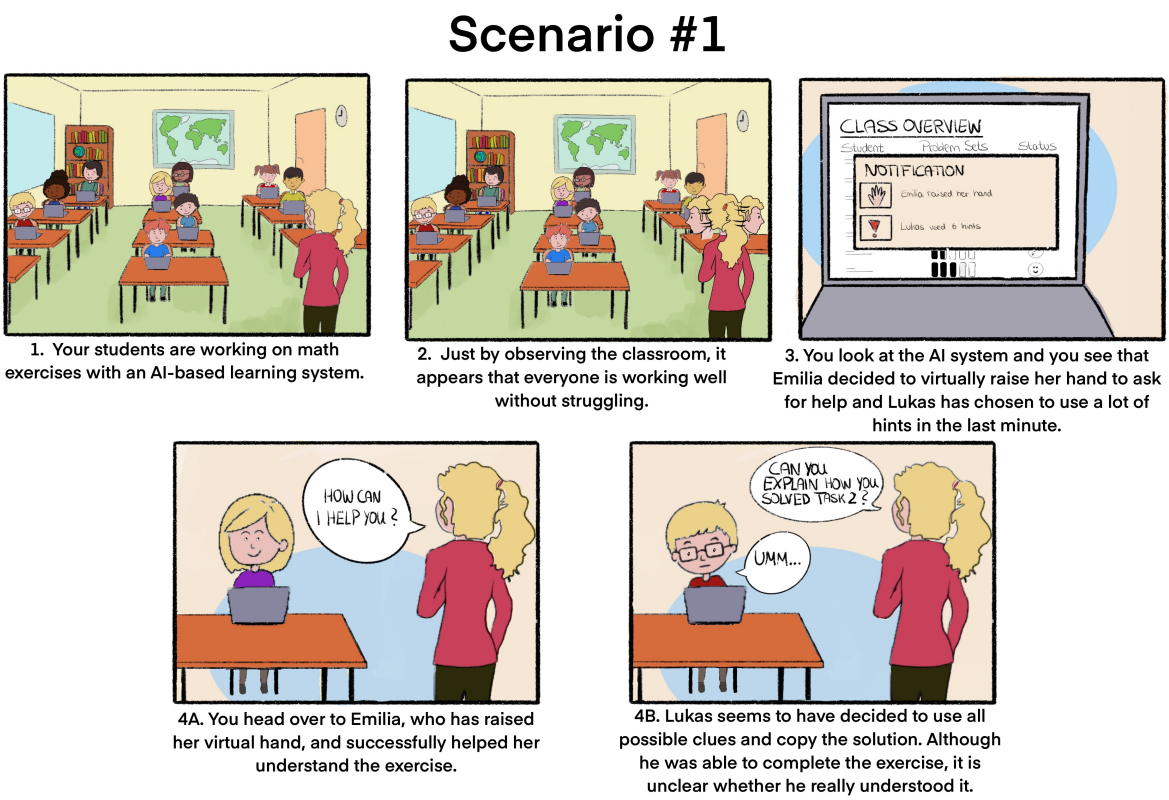
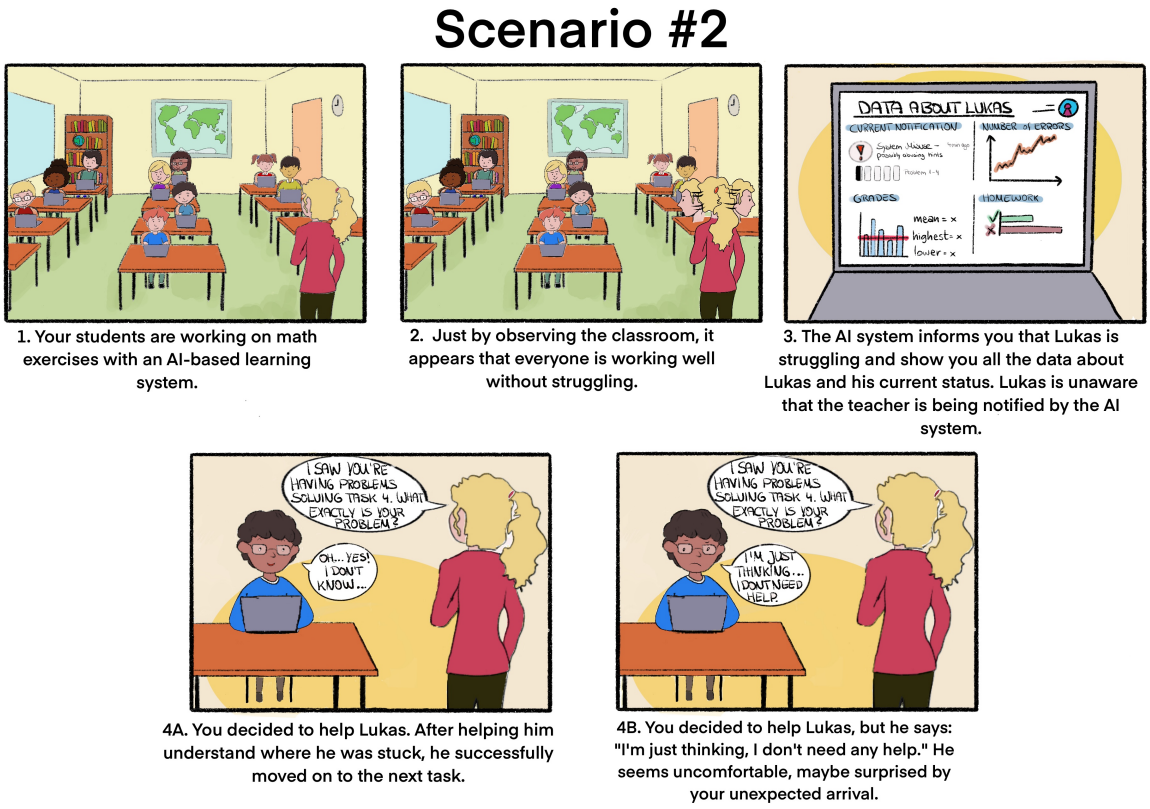


Figure I2

Teacher Scenario 2: Full AI control over getting feedback and help



1. Your students are working on math exercises with an AI-based learning system.

2. Just by observing the classroom, it appears that everyone is working well without struggling.

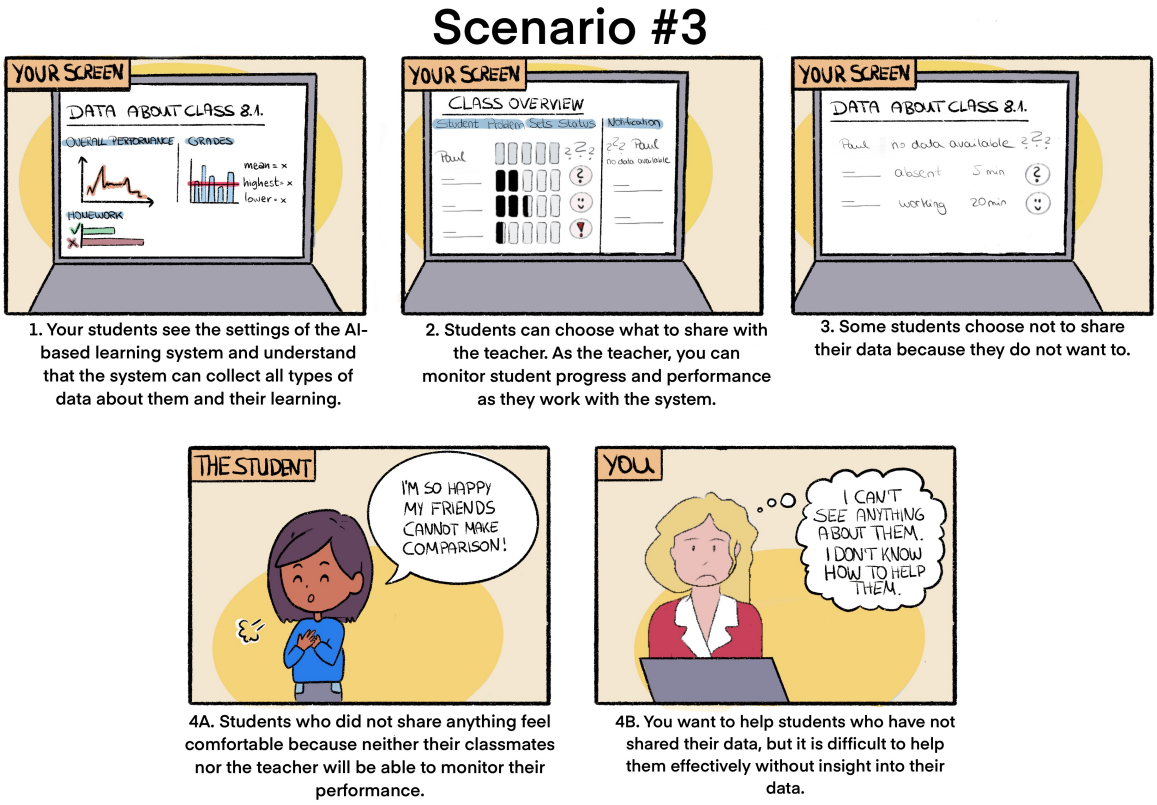
3. The AI system informs you that Lukas is struggling and show you all the data about Lukas and his current status. Lukas is unaware that the teacher is being notified by the AI system.

4A. You decided to help Lukas. After helping him understand where he was stuck, he successfully moved on to the next task.

4B. You decided to help Lukas, but he says: "I'm just thinking, I don't need any help." He seems uncomfortable, maybe surprised by your unexpected arrival.

Figure I3

Teacher Scenario 3: Full learner control over data sharing



1. Your students see the settings of the AI-based learning system and understand that the system can collect all types of data about them and their learning.

2. Students can choose what to share with the teacher. As the teacher, you can monitor student progress and performance as they work with the system.

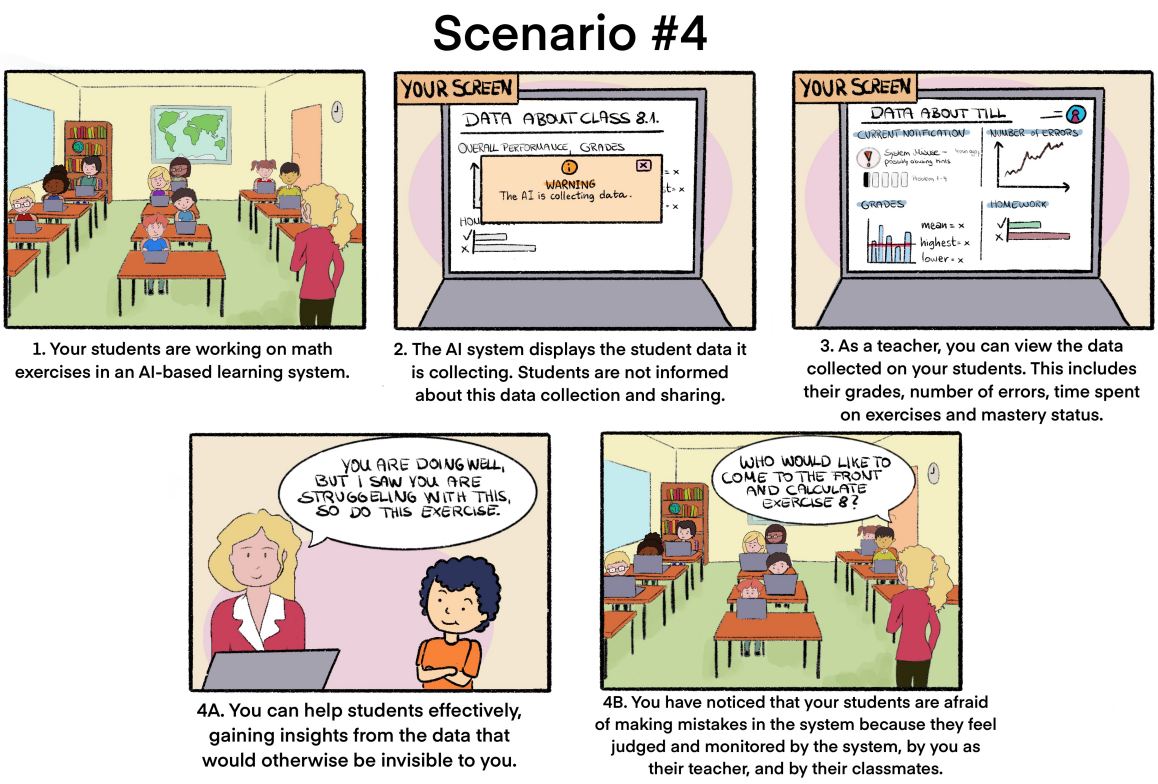
3. Some students choose not to share their data because they do not want to.

4A. Students who did not share anything feel comfortable because neither their classmates nor the teacher will be able to monitor their performance.

4B. You want to help students who have not shared their data, but it is difficult to help them effectively without insight into their data.

Figure I4

Teacher Scenario 4: Full AI control over data sharing



1. Your students are working on math exercises in an AI-based learning system.

2. The AI system displays the student data it is collecting. Students are not informed about this data collection and sharing.

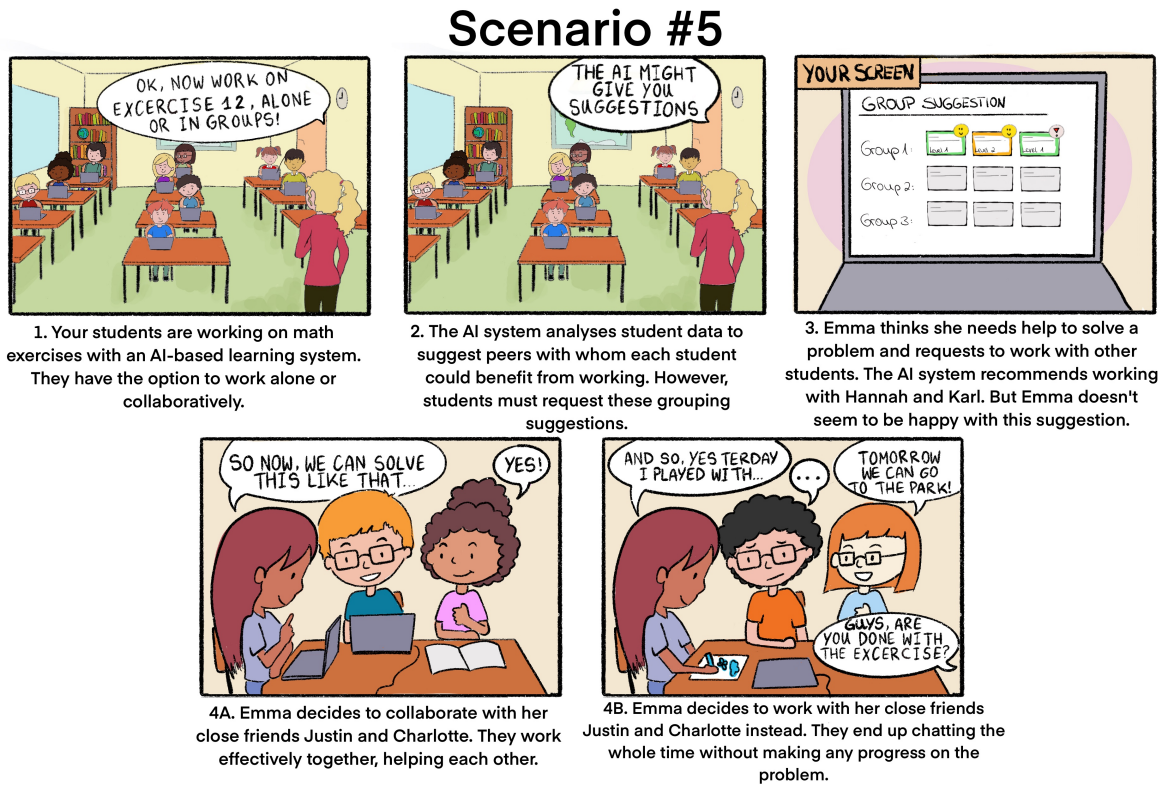
3. As a teacher, you can view the data collected on your students. This includes their grades, number of errors, time spent on exercises and mastery status.

4A. You can help students effectively, gaining insights from the data that would otherwise be invisible to you.

4B. You have noticed that your students are afraid of making mistakes in the system because they feel judged and monitored by the system, by you as their teacher, and by their classmates.

Figure I5

Teacher Scenario 5: Full learner control of classroom orchestration



1. Your students are working on math exercises with an AI-based learning system. They have the option to work alone or collaboratively.

2. The AI system analyses student data to suggest peers with whom each student could benefit from working. However, students must request these grouping suggestions.

3. Emma thinks she needs help to solve a problem and requests to work with other students. The AI system recommends working with Hannah and Karl. But Emma doesn't seem to be happy with this suggestion.

4A. Emma decides to collaborate with her close friends Justin and Charlotte. They work effectively together, helping each other.

4B. Emma decides to work with her close friends Justin and Charlotte instead. They end up chatting the whole time without making any progress on the problem.

Figure I6

Teacher Scenario 6: Full AI control of classroom orchestration

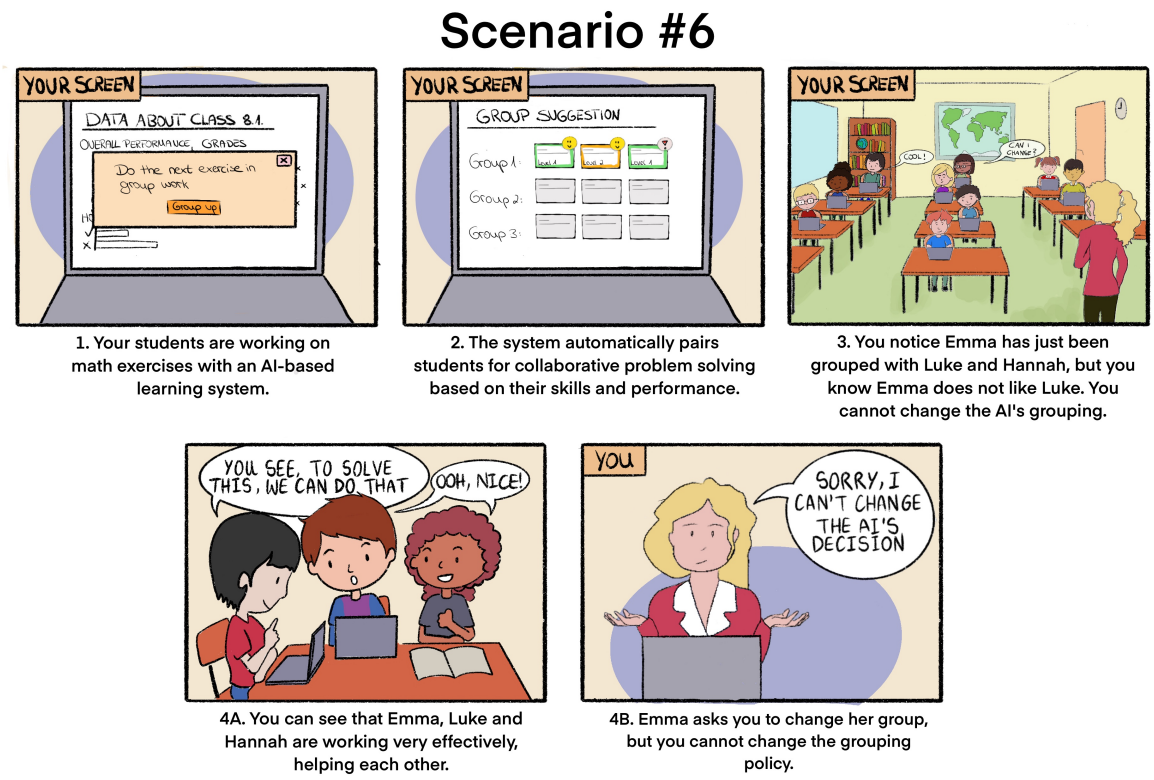


Figure I7

Teacher Scenario 7: Full learner control over educational content

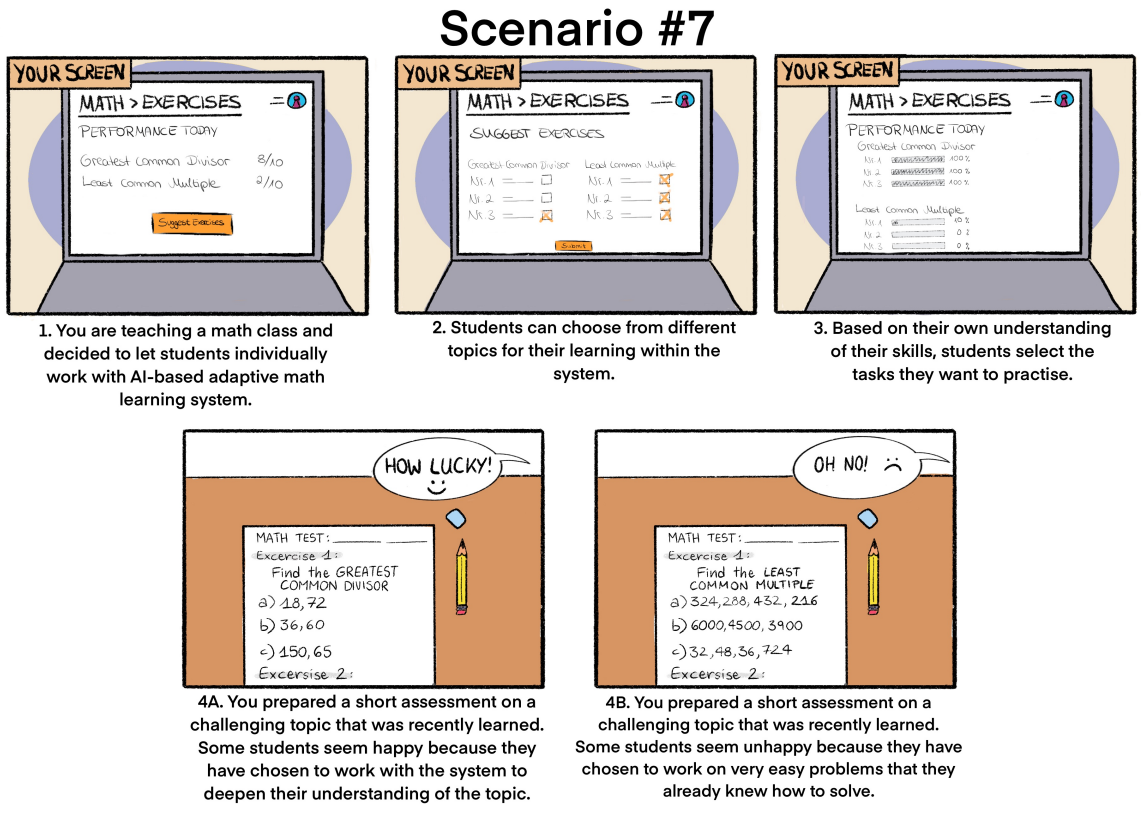
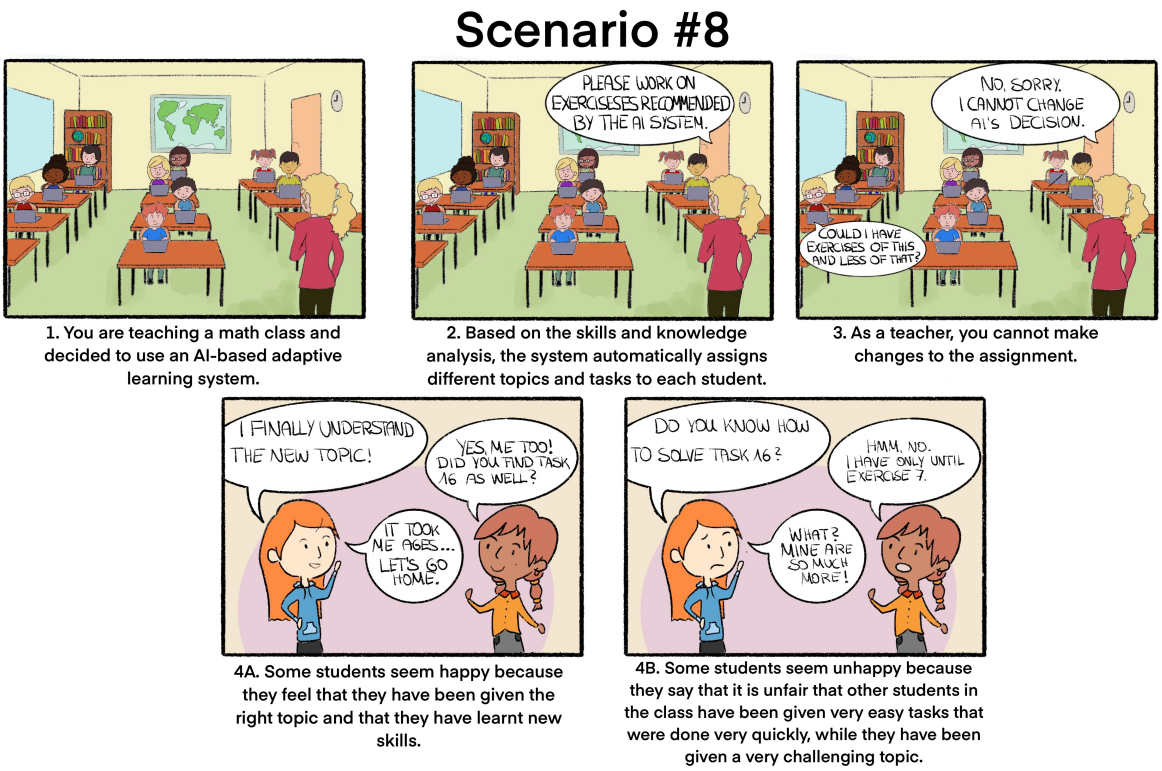


Figure I8

Teacher Scenario 7: Full AI control over educational content



1. You are teaching a math class and decided to use an AI-based adaptive learning system.

2. Based on the skills and knowledge analysis, the system automatically assigns different topics and tasks to each student.

3. As a teacher, you cannot make changes to the assignment.

4A. Some students seem happy because they feel that they have been given the right topic and that they have learnt new skills.

4B. Some students seem unhappy because they say that it is unfair that other students in the class have been given very easy tasks that were done very quickly, while they have been given a very challenging topic.