

# Teachers' Perceptions on the Integration of Natural Language AI in Education

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## **Abstract**

The purpose of this research was to collect teacher perceptions on the use of AI in education. AI is rapidly expanding and has continuously shaped the educational landscape in the past years. Collecting teachers' perceptions can show how these changes affect education in a secondary school as well as teacher trainer level. The study used semi-structured interviews which were coded for relevant themes. Results showed that teachers have ideas for wanted implementations but lack knowledge of such tools to implement these changes themselves. Perceptions show that teachers want a unified working method of using AI in education. Future work should focus on a wider variety of participants and test some of the wanted implementations by teachers to check for their validity in real-world applications.

## 1. Introduction

The Dutch government has recently published a vision statement describing use of generative AI. Alexandra van Huffelen, the minister of digitalization, states “We wish to retain the values and prosperity of the Netherlands [...] up to sixty percent of jobs could be affected by AI [...] What is also needed is a government that has ambition and vision based on public values and our objectives [...] By stating our principles now, we will maintain control in the future” (Government of the Netherlands, 2024). This statement suggests that the Netherlands aims to adapt to AI technology. Whilst not specifically stated, the sixty percent quota reflects that Dutch educators will also likely be affected, and that the Netherlands encourages the use of AI in education. This can also be seen by the NLAI coalition's aims, a country-wide organization which is focused on personalizing education with AI (NLAI coalition, 2023). In addition, the Netherlands is currently developing a GPT-NL, an AI which is designed to be integrated into the Dutch workforce. This model will also be linked to academia in the Netherlands, making it a potential use case for future educational purposes (Digitale Overheid, 2023). Adjusting to this change is therefore relevant for educational systems throughout the Netherlands.

Yet, teachers first need to adapt to these changes themselves, facing many potential benefits and threats to the effectiveness of learning posed by AI use. This study aims to gain insights into how teacher trainers perceive such changes in education, with a focus on the increased use of natural language AI by both students and teachers. The study will look at wanted implementations and current adaptations of teacher trainers to this emerging technology. After this, the study collects current perceptions on the use of AI tools by teacher trainers in teaching and learning. Lastly, the advantages and pitfalls of AI use in education will be highlighted.

Two major terms that will be discussed within the frame of AI using natural language are natural language processing (NLP) and large language models (LLMs). “Natural language processing combines computational linguistics—rule-based modeling of human language—with statistical and machine learning models to enable computers and digital devices to recognize, understand and generate text and speech” (IBM, 2024). Within this branch there exist LLMs, models trained on vast amounts of language data applicable to many general tasks. These tasks can range from translating to summarizing and generating new text. Platforms that use NLP

include Grammarly, Duolingo, and Google Translate. More well-known tools using LLMs include ChatGPT, a generative pre-trained transformer (OpenAI, 2023), Gemini, a multimodal AI that can convert various modes of communication (Pichai and Hassabis, 2023) and Microsoft copilot (Spataro, 2023).

Large Language Models such as these are commonly used in education, with sources estimating the use of such tools at around 43 percent of American students to 92 percent of Dutch students (in these cases an OpenAI GPT model) for academic purposes (Erasmus magazine, 2024; Forbes, 2023). Such frequency of use raises the question of whether these tools should be used more transparently, making concrete distinctions between proper and improper AI use in an academic setting for both students and teachers. Gaining insights into teachers' perspectives also aims to show how students are using the tool, to which extent they are open about their use, and how AI is affecting education and comprehension levels.

### **1.1 Research questions**

The following research questions and sub-questions have been developed to explore the perceptions of teacher trainers. Teacher trainers have experience with secondary education, making them suitable participants for interviews about both secondary education and teacher trainer implementation.

Research question 1: What perceptions do teacher trainers have on current and wanted implementations of AI in education?

Research question 2: How do teacher trainers perceive educational changes in teaching and learning caused by AI?

Research question 3: What are the current benefits and risks and concerns for teacher trainers, secondary teachers and their students?

## **2. Theoretical background**

### **2.1 Perceptions of teachers**

The study's focus on AI as emerging technologies in education. The Digital Competence Framework for Educators (DigCompEdu), as well as the SELFIEforTEACHERS program both show relevance to this topic and were used as theoretical backgrounds. These frameworks include many sections of education and ethical guidelines on the use of AI to conduct a qualitative analysis of high school teachers' perceptions of the use of natural language AI in education (DigCompEdu, 2017; SELFIE for Teachers, 2020). These resources were chosen as they show on a large scale how EU education is adapting to digital technologies. DigCompEdu focuses on a general overview on the impact of digital resources on education, with the SELFIEforTEACHERS program collecting reflective feedback from teachers about such uses. These frameworks pursue gaining knowledge on teacher perceptions about technology in education throughout Europe, a similar intention to this study. This makes them relevant components of the theoretical framework.

Due to the recent technological advancements in natural language AI, there are numerous new articles on the subject. Many of them focus on specific aspects of higher education, such as engineering (Bernabei et al., 2023) and medicine (Waisberg et al., 2023). The bibliometric and content analysis by Bahroun et al. (2023) shows how 207 of these studies focus on research to concern assessment, personalized learning support, and intelligent tutoring systems, as well as focusing on ethical considerations on AIED. These sources can be extremely useful when developing strategies for future implementations in education and other fields, although they do not concern themselves with showing current adaptations to Dutch secondary education. The following sections will explore how AI affects teaching and learning practices and evaluate the impact of technological acceptance on the use of AI in education.

### **2.2 The use of AI for teaching and learning**

AI has been increasingly integrated into educational settings, transforming the teaching and learning landscape. As far back as in the 1920s, AI was employed for generative tasks such

as content creation through "teaching machines", which used algorithms to provide course material (Rhandawa & Jackson, 2020). A full timeline of educational uses can be seen in Annex C. With advancements in machine learning and NLP, AI expanded its role in education to include adaptive learning platforms, educational games, and virtual tutors (Graesser et al., 2018).

Chatbots and virtual assistants powered by NLP facilitate instant responses to students' queries, offer explanations, and guide course materials (D'Mello et al., 2017). This assistance could be used in an academic setting in which a teacher is not available, as well as providing teachers with the opportunity to see common questions and ways of working, if the student's progress with the AI is shared. Moreover, NLP algorithms analyze students' written assignments to provide feedback on grammar, coherence, and content, enhancing the quality of writing instruction (Petchprasert, 2021). Due to the EU AI act such uses pose a high risk, as the lack of control such technologies can offer requires a human teacher to evaluate a student's progress formally (EU AI Act, 2024). Rather, the technology serves the student in learning and continuously improving their written assignments independently.

This can be seen in a variety of online tools available to teachers and students. Duolingo is an example of how learning platforms incorporate AI technologies to create adaptive learning and gamify the learning process (Henry, 2023). It does this by generating language learning questions in diverse ways, including pictures and puzzle-like questions for students to answer. Handini et al. (2022) showed that the use of AI tools in educational tools like this does show a significant boost in both listening and writing skills. Campfire (2023) is a virtual AI tutor in the form of a chatbot. Students can ask questions on various scientific topics and receive immediate answers, with an option to talk to a human if there is any confusion on the AI's response. These technologies are called intelligent tutoring systems (ITS) and have been shown to significantly improve student learning through personalization of materials and adaptation to the students' pace of learning (Al-aqbi et al., 2019).



### **2.3 Technology acceptance based on benefits and risks and concerns**

This segment focuses on professional engagement and empowering learner's sections of the DigCompEdu framework. A study by Ezzaouia et al. (2022) explores STEM teachers' perceptions of AI-based educational tools for scientific writing. The study's findings reveal that teachers appreciate AI's ability to offer superior scaffolding and individualized support, enhancing the learning experience. Another study by Nazaretsky et al. (2023) investigates the factors that influence teachers' trust in AIED technologies across six countries. The research identifies perceived benefits, such as enhanced learning and productivity, as significant determinants of trust.

However, it also highlights concerns about AI's reliability and its potential to disrupt interpersonal communication in classrooms. The study emphasizes the importance of developing clear guidelines and professional development programs to build teachers' confidence and competence in using AI tools effectively. Incorporating such guidelines could be crucial in gaining technological acceptance and incorporation into the classrooms. To set guidelines and gain wider technological acceptance, perceptions of the benefits and risks and concerns regarding education must be further assessed. Since access to professional development for teachers is limited after their initial training, incorporating such change is difficult (Husband, 2019). This makes teacher trainers' perceptions on incorporating such educational changes relevant, as they will have the biggest impact on educational changes.

### **3. Methodology**

#### **3.1 Design**

The approach of this study is qualitative, using semi-structured interviews. This paper focuses on questions regarding the following aspects from the DigCompEdu framework: Professional engagement, Digital resources, Teaching and learning and facilitating learners' digital competence. The interview scheme used in this research adapted questions from these segments using the SELFIEforTEACHERS form. Professional engagement is important to measure teachers' perceptions towards adapting to such technologies. Digital resources show how teachers are or could implement AI in education, and what their knowledge of these resources is. Teaching and learning focus on various aspects centered on perceived impacts of AI integration in education. Facilitating learners' competence was used to research impacts on student learning and potential benefits and risks arising from official integrations of AIED. The statements from the framework were adapted into questions. Below is an example demonstrating how a statement was adapted from the SELFIEforTEACHERS framework to fit into the context of this study.

Example of original Statement: Creating digital resources that support and enhance teaching and learning aims.

Adapted question: To what extent do you use AI to create digital resources that support and enhance teaching and learning aims?

#### **3.2 Participants**

The study sampled eight teacher trainers working in the Dutch educational system. It is important to mention that all participants had prior experience as secondary school educators, but not all participants are currently teaching in secondary education. Therefore, their statements reflect their experiences as a teacher and a teacher trainer. The study used purposive convenience sampling. The teacher trainers were chosen based on their availability and diversity in educational backgrounds. All participants were employed at the University of Twente as teacher trainers. All participants are also currently working, or have worked, as teachers in secondary education. These participants were chosen to show how the use of natural language

AI affects the work of secondary teachers and teacher trainers, showing what perceptions of AI integrations could look like from a dual perspective. Six participants identified as female, and two as male. All participants had a degree in education, with work experience ranging from two to thirty-five years.

### **3.3 Materials**

Materials used for the project were a MacBook M1 for recording and taking notes. An iPhone 12 was used as a backup recording device in case the MacBook were to face technical difficulties. Printed informed consent forms were provided and filled out to ensure safe procedure and inform the participant on the prerequisites of participation (Annex E). A physical copy of the questionnaire relating to the theoretical framework was provided to ensure clarity in comprehension (Annex F). All supporting documents were provided both in English and in Dutch to ensure that the terms of the study were sufficiently clear. Digital analysis tools used included Scribbr and *Microsoft Office Word* for notation purposes, *Atlas.ti* to code the interviews and *Google Translate* for the translation of the provided materials. The DigCompEdu framework was used to develop the interview structure, with questions from the SELFIEforTEACHERS questionnaire being adapted to explore AIED uses. This can be seen throughout the interview structure (Annex F) as each question header is a section of the SELFIEforTEACHERS questionnaire. The adapted headers were as follows: teaching and learning, facilitating teacher's competence and professional engagement

### **3.4 Procedure**

After the interview structure was finalized and discussed with the supervisors, a room was reserved on the school grounds where the interviews took place. All documents were provided in English and Dutch. Each interview had around 7000-15000 words, including the questions asked by the researcher and the responses by teachers. At the start of the interview, each teacher received a consent form and a copy of the questions, found in Annex E and F. Each interview lasted 30-45 minutes and was recorded on two devices using the built-in Voice Memo application. This ensured safe independent recordings which could later be transcribed. All

interviews are transcribed with the help of Atlas.ti. Transcriptions are then manually corrected using accompanying interview audio to check for any discrepancies.

### **3.5 Analysis**

This research used deductive coding. *Atlas.ti* was used to analyze the interviews, which uses codes to structure and visualize themes within the data. Open coding was used, and codes were identified based on the questions asked as well as the research questions discussed previously. The main aim of coding the interviews was to visualize and quantify some of the data, giving more accurate, objective descriptions of the teacher's perceptions. All interviews were assessed twice to sort and categorize themes encompassing various codes. The initial analysis used codes and a second analysis summarized codes into relevant themes. Individual quotes were organized by using the *Atlas.ti* quote manager.

The analysis of teacher educators was organized into three categories. The first category was teachers' personal perceptions of the tool. This category aimed to capture the responses and establish general perceptions outside of professional use. The second category is called teaching and learning. This section aimed to measure the impact teachers face of increased AI use, both positive and negative. It encompasses concepts such as current use, wanted implementations, and self-regulated learning. The learning aspect also aimed to encompass educators' perspectives on student use, showing perspectives on desired and undesired use, both for current and future possible integrations in AIED. The third category aimed to give clarity on current and wanted implementations by providing perceptions regarding the participants' perspective on the integration of AI in education as a teacher trainer. This aimed to provide insight into the use cases of AI in education and possible implementations of teacher trainers.

Each category contains a list of codes analyzed for relevance through the number of mentions. This aimed to quantify the data. To capture the singular significance of individual codes, a category used for bookmarking was also added. An interrater reliability test was performed by another researcher to check the validity of selected quotes.

## 4. Results

The results section used codes which were applied using frequency of teacher mentions rather than total mentions. This was done with the aim to argue for a majority view on AIED perceptions rather than a total number of mentions. Findings contain a summary of the most relevant themes for each group; full tables of the results can be found in Annex G. An interrater reliability was conducted on the Annex to validate the choice of codes applied. The kappa value was 0.80.

### 4.1 Perceptions on current and wanted implementations

Throughout the eight interviews, teachers focused on mentions of current use and wanted implementations. Wanted implementations included setting official regulations for AI in education and pushing for organized classes that promote ethical use (Table 1). Teachers wanted the technology to be implemented clearly, so that it is not left up to the students to use AI in any way they choose, potentially harming their learning. Mentions of current uses focused on aspects such as encouraging AI use for idea generation and grammar checks, and openly discussing AI use in an academic setting with students.

*Table 1: Themes related to personal perceptions*

Theme	Frequency	Example
Wanted implementations	8/8	I think we have to deal with it. If you have a big group of students, you never know if they all have the same moral compass. So I think you should say in the beginning clearly to what extent you allow them to use AI and for what things and what things not. -Transcript 8
Current use of AI in teaching	5/8	I think if we agree on how, for instance, university level or school level or whatever level. If there's really a policy that is shared by everyone, then I think it should be more detailed. But at the moment, most of these instances don't have this policy. -Transcript 3

Mentions of lack of knowledge on AI use and mentions of lack of need to use AI in an educational landscape were mentioned amongst some teachers (Table 2). These mentions often did not emphasize lack of want to use AI for current education purposes but posed critical views on the AI's reliability in its output. This coupled with a lack of distinct need to use the technologies as it is not a required tool for teachers caused a high frequency in mentions. In addition to this, a lack of time for teachers to learn how to use AI also contributed to a lack of need to adapt to such technologies. This was correlated with the lack of knowledge of AI tools, as teachers do see it as a useful tool overall, but simply do not have the need or time to get acquainted with such new technology.

*Table 2: Perceptions on needing AI tools in education*

<b>Theme</b>	<b>Frequency</b>	<b>Example</b>
Lack of need and time to use AI tools	7/8	I absolutely like to incorporate AI as a new tool and with possibilities, but I don't want to spend too much time on it as this is the whole new thing, because it's as it's a new tool along with other tools. -Transcript 7
Lack of knowledge on AI tools	6/8	I don't know, because also I don't know everything about it. So, we're also doing something, and I'm not sure if I'm doing the right thing. So, yeah, it will be a matter of time to know if it's good or not. -Transcript 4

#### **4.2 Perceptions of teacher trainers of AI and its impact on teaching and learning**

This segment focuses on research question two. Teacher trainers perceive a need to get acquainted with the technology, with mentions of the effect on teacher occupation. This is often associated with the inevitability of AI integration into the educational landscape. Every teacher trainer exhibited some previous knowledge, ranging from minor personal research to participation in previous AIED hackathons, an event aimed at creating innovative software to aid

developments in education (Table 3). All teacher trainers showed some professional development and familiarity with AI. However, this familiarity mostly extended to theoretical use of AI tools, with only two out of eight teacher trainers exhibiting practical knowledge of AI uses. Teacher trainers have acknowledged this and are currently designing a class where they explore AIED uses with their students. Teacher trainers showed interest in using AI, seven of them displayed motivation to use such tools. These motivations are centered around helping students develop skills such as coding or academic writing, but some teacher trainers mentioned interest in AI use for test generation and class content creation as well. This is also a useful skill for their teacher trainees, as it helps them in designing classes for their students in the future. Collaborative use was also briefly mentioned, with most teacher trainers willing to take suggestions from AI, but not wanting to use AI to automate communications. This further shows the relevance of the human factor in education.

*Table 3: Effect on teacher occupation/ use as a teacher*

<b>Theme</b>	<b>Frequency</b>	<b>Example</b>
Familiarity with AI	8/8	I know some things about AI, but because I don't know all the possibilities, it's difficult for me to say, oh, it has to look like that. I did the hackathon AI, and what I heard about that, it all shapes how you think about AI. - Transcript 4
Professional development	8/8	Yeah, knowledge of ethical use. At my school and at most schools, there is not such a program yet. So we are convinced it's very important and we have no idea how to implement it. -Transcript 3  Yes, I think we have a task here as educators and especially as teacher-educators. -Transcript 2

Perceptions on collaborative use	8/8	And I prefer human conversation but I also see that sometimes it may take time if you have automatic response. I still would prefer that you only use it as suggestions and then look at it. I don't like the idea that you only get answers from a chatbot without human interference. -Transcript 2
Teachers motivation to use AI	7/8	Yes, I know that with programming education they are looking at how to give feedback on code construction. They are also even looking at correcting tasks with AI. It depends if you really have a lot of tasks, much work, which all is the same, then you can automate it, I think. -Transcript 2

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Teacher trainers deem the integration of AI in education as inevitable, resulting in most teachers having concrete opinions on the impact on education (Table 4). Some teacher trainers believe that AI should be implemented in primary education, whilst others are skeptical of its involvement in primary and secondary education, suggesting a later onset of when to implement AIED practices. This is tied to concerns with the student's ability to reflect on text provided by an AI. For example, if AI were used too early in secondary education, it could hinder students critical thinking abilities. Selective use is also discussed, with students not always relying on AI use, but rather using it as a tool to help with initial steps or generate comparative texts for students to analyze and evaluate. Teacher trainers were not worried about job displacement due to AI. The only concrete mention of such displacement was regarding AI's ability to uncover teachers that are already not qualified for teaching.



Table 4: Effects on Education

Theme	Frequency	Example
Perceived impact of AI in education	8/8	[...] you can't stop that [students using AI]. Nothing about me to want it or not want it. -Transcript 8  I really think that everybody has to learn to use them in a responsible way. We already talked about how to educate your students, so I think they also should be able to look at the responsibility, but also the freedom to do so. -Transcript 2
Impact on secondary education	7/8	Instead of generating sometimes it is nicer to just make something for yourself. Okay. So this is also sometimes when you would not encourage your students to do so or would not like want to have teachers educate your students about this because you don't want the students to lose that individual impact they could have in their writing. -Transcript 5
Job displacement	1/8	And, but the dance is not, it is less in the tool itself. The danger is more in that people will still have their education... But it's still, not AI, it's still... I think the bad apples will come to the surface. -Transcript 7

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### 4.3 Benefits and Risks and Concerns

This section focuses on the third research question, which covers potential uses of AI in education, their benefits and risks. Potential benefits were mentioned slightly more than risks and concerns in overall mentions, but all teachers mentioned both benefits and risks throughout their interviews (Table 5). This shows that teachers had mixed perceptions of the usefulness of

AI in education, depending on the context of the tool's use. Positive mentions of the tool involved regulations enforcing reflective use, teacher interventions and encouragements, and helping students develop their assignments, learning to incorporate AI as a useful tool in their learning process. Teachers mentioned these benefits as a sort of introduction to conducting research and writing, with the aim of getting students interested in topics and then using their own skills to develop and write out ideas. The use of AI could also help teachers to provide better feedback, as they can ask students to share their progress using the AI in a process called 'supervised personalized learning'. Teachers also perceived it as a helpful tool for themselves that can generate assignments for them to implement in classes, allowing them to focus less on the design of a class and more on the teacher-student relationship. Currently, teacher trainers are implementing a course at the University of Twente to help identify which tools could be used to aid in teacher tasks. This course lets teacher trainees discover and present such tools, helping both teachers and students to discover AIED uses. Teachers saw a particular benefit in regulated implementations, which would help them and their students learn to use these tools professionally.

Risks and concerns were that students will not reflect on their use of AI, essentially viewing the AI as a black box that is taken as definitive proof without questioning the answers it provides, jeopardizing critical thinking skills. Another risk is that students will use these tools without teacher intervention, which would make use unpredictable and harm student engagement and overall learning. Unregulated uses were most mentioned, which further emphasizes the need for regulation in AIED implementations. This was also reflected in the themes of reflective usage and educator encouragement. Standardizing use could shift focus on reflective and responsible use of AI, both aspects which are currently viewed as undervalued by students and risks of AI use in education. Teachers also saw some risk in automatic responses by their colleagues, with all teachers agreeing that they would not want this to occur. However, teachers use AIs to rewrite some of their emails to help with formality, which could be considered as partial automation.

*Table 5: Potential benefits, risks and concerns*

<b>Theme</b>	<b>Frequency</b>	<b>Example</b>
Potential benefit	8/8	And then you can definitely use AI in secondary education to help them along with any kind of project to get ideas, to teach them how to ask the right questions towards AI, not just simply repeat the question... And I think in that sense they can learn a lot... I think there is a lot of AI that can be implemented so that the students get the right kind of questions back. -Transcript 1
Risks and concerns	8/8	"It also changes sometimes. Then it is actually a degeneration if you leave everything to AI. And that is of course also a risk. I think that you can stimulate metacognition if you really critically use it. But if you don't be critical, then you lose your critical power and your reflective power, I think." - Transcript 5
Educator encouragement	8/8	I really think that everybody has to learn to use them in a responsible way. We already talked about how to educate your students, so I think they also should be able to look at the responsibility, but also the freedom to do so. -Transcript 2

Need for  
reflective use by  
students

7/8

They are critical on the information they get. And that was the solution for Wikipedia. That's the solution for AIs well. And, um, there's only one way to, to learn them, to confront them with the mistakes.

-Transcript 7

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## 5. Discussion

### 5.1 Summary of findings

This paper interviewed teacher trainers, who either still work as secondary teachers or have done so in the past. The results showed that generally, educators struggle to use generative natural language AI tools for varying reasons. Perhaps most notable is the lack of systems to teach educators how to implement such resources. Even though teacher trainers exhibit some professional development, it mostly stems from personal interest, and they exhibited a lack of knowledge on use cases and implementation methods in education. Teacher trainers are currently not sufficiently experienced with AI tools to integrate them into their education, creating a lack of knowledge for future secondary teachers. Since last year, most teacher trainers report that schools lifted the ban of AI use. However, there are no guidelines on a regional or national level that shed clarity on how teachers could use AI.

When conducting the interviews, it was clear that all teacher trainers had some familiarity with AI tools, but did this out of their own interest, with little official information given on how to use these tools for teaching and learning (some examples of information are voluntary activities such as guest lectures, colleague discussions and the hackathon). Despite this, teacher trainers motivate the use of AI by giving teacher lectures on potential uses. However, this is done through their teacher trainees acquiring knowledge on AI tools they find for teaching and learning, as the teacher trainers themselves are unfamiliar with what concrete tools could be used for AIED. This further shows that there is a general lack of expertise when it comes to AI in the educational system.

It is a strange result, as educators find it important to integrate it into secondary education and see potential dangers in doing so. For example, a need for students to reflect on their use was mentioned frequently amongst educators but is currently not encouraged in their curriculum. It is a difficult, yet pivotal point in AIED, as educators perceive use to become inevitable, but largely also believe that it is too early to officially introduce AI into classes. The lack of knowledge on AI uses also inhibits educators from informing and standardizing use, with

the only lack of resources mentioned in secondary systems being a lack of people with expertise. The following sections will discuss findings of each research question.

Research question 1: What perceptions do teacher trainers have on current and wanted implementations of AI in education?

Current perceptions show that teachers believe AIED to be "inevitable", but many think current integration would be too soon, as there is a lack of need to use AI. This does not mean that teachers would not like to use such technologies, but rather refers to other priorities they have. All teachers mention that AI technology influences student engagement, with almost all teachers perceiving secondary students to use such technologies already. Use amongst teachers in training is low, with few teacher trainees knowing how to apply such technologies. Teacher trainers are not concerned with job displacement due to AI, but rather see it as another tool they can use and need to adapt to. This tool is regarded as quite useful by some, who are already using it to work on their digital politeness in feedback through emails and comments, help with coming up with headers for academic texts, and generate ideas on teaching methods. It is important to mention that knowledge of AI tools and their uses vary greatly, but perceptions of uses are rather similar throughout the interviews. All participants have some form of interest and would like to implement the technology to some extent, varying from raising student awareness of its dangers to encouraging active implementations, and none of the teachers were afraid of AI taking away the human aspect of teaching and learning.

Research question 2: How do teacher trainers perceive educational changes in teaching and learning caused by AI?

Currently, AI use is not standardized and varies greatly. Some teachers encourage students to use AI to help them generate ideas and learn better ways of writing, whilst others are too unfamiliar to recommend any use. There is a course in which teacher trainees will be tasked with finding AI tools that can be useful in education, and then showing teacher trainers their use cases. This course aims to help trainees to become more familiar with such resources, but it also shows a lack of expertise in the AIED field. When it comes to secondary education,

similar results are found. Teachers must continuously adapt to various tools and tasks, finding little time to adapt to AI technology. Nevertheless, some teachers report that it is actively changing the classroom, through student attentiveness, independent learning, hindrance of critical thinking, and a change in how written assignments are completed. There are many negatives' teachers mention on the current and future uses of AI in education, but most refer to improper handling of such implementations. That said, use is encouraged but needs to be implemented on a standardized level.

Research question 3: What are the current benefits and risks and concerns for teacher trainers, secondary teachers and their students?

Current wanted uses vary from teacher to teacher, with common uses being idea generation, supervised personalized learning, and help with academic writing. Teachers believe that both their secondary school students and teacher trainees can greatly benefit from using AI properly. The goal of AI use is to help teacher trainees generate academic material and help with their workflow, as well as learn to write academically. Secondary students also are encouraged to use tools to develop their writing skills and pursue some individual learning but with a heavier emphasis on the regulation of acquiring such skills.

Undesired uses include use without reflection, automation of communication between colleagues, and unregulated learning. Most undesired uses are specifically mentioned for secondary students, as they are more susceptible to negative learning outcomes of improper AI use. Major worries teachers discussed here were lack of critical thinking skills, automating their assignments and less overall effectiveness in learning.

Effects of positive uses show promise to enhance learning, whilst negative effects could lead students to lessen their learning potential due to effectiveness of their learning tasks.

## **5.2 Strengths and Limitations**

This paper was able to identify educator perspectives on AIED. Various methodological strengths made this possible. Firstly, the research used qualitative analysis methods, which more accurately depict an individual's perception. Quantifying this data through measures of

frequency of mentions provides an overview of perceptions of teachers, which, alongside highlighted statements, gives relevant insights into their perspectives. In addition, interview coding and semi-structured interviews allow for the study's replicability, but on different populations with varying results. AIED perceptions of teacher trainers are relevant for current developments, as the participants qualify as domain experts, with the potential to inflict change on larger educational structures. The trainers were from diverse backgrounds, with diverse specializations. This helps in identifying the impact of AIED in different educational fields, such as computer science, mathematics and chemistry.

There are various limitations of this study, which could be regarded in future research. Firstly, the sample size is too narrow. This is due to convenience sampling including solely educators employed at the University of Twente. A factor to consider when weighing the impacts of the teacher trainers' perspectives is the reach they have over teachers in the Netherlands. Despite this, some of the teacher trainers are not currently employed as secondary teachers. This had implications for the dataset, as it was hard to distinguish when a teacher was referencing their experience with secondary students or teacher trainees. The lack of generalization of results in a larger population is also difficult due to the qualitative analysis approach, limiting the results to an introduction to perceptions of teacher educators in AIED, not definitive statements that can be generalized for all teacher educators in the Netherlands. Biases due to interpreted mentions were measured using interrater reliability of the results on Annex G, obtaining a kappa value of 80%.

### **5.3 Directions for future research**

Based on the limitations of this study and other factors, there are several directions for future research. First, the research could be directly replicated to compare other teacher educators in various regions of the Netherlands. This would enable comparative studies as well as open possibilities of quantitative generalizations. Replication of the study would also allow for more varied deviations of the semi-structured interview, possibly leading to a more holistic view of AIED perceptions. Interviews with teachers, administrators, students and other educational figures could also be conducted to gain added perspectives on AI in education. During the interviews the changing landscape of the field was emphasized. Longitudinal studies of the



development of teacher perceptions could therefore be conducted continuously to account for change of perspectives over time.

#### **5.4 Implications**

This paper aims to show current uses and perceptions of the integration of AI in education. The results showed that there were not many teacher trainers actively using AI, with most trainers having little knowledge of applications of AI in teaching and a lack of oversight on the topic. This finding is relevant, as it shows that currently, AIED is not commonly discussed in education, and implementations in schools are either used without clear guidelines or are restricted. The perspectives of teacher trainers were positive, with many saying that it is a technology that can change the educational landscape. This being said, AI is also currently affecting secondary education, as students are using it regardless of educational policies. This research therefore contributes to demonstrating the effects of AI on education. Through the interpretation of teacher trainers, this research shows how AI can potentially help as well as harm educational development, with aspects such as reflective use, guided self-learning and AI aid with developing an academic writing style at the center of the discussion. Through these perceptions, new innovations based on teacher trainer suggestions can be developed and integrated, helping both teacher and student to adjust and improve their academic progress.

#### **5.5 Conclusion**

This paper shows teacher educators' perspectives on AI integrations in education. It uses qualitative data collected through semi-structured interviews to show how teachers currently think about AIED, its effects on education, and possible future implementations of AI. Teachers currently are not using it to a great extent but believe that integration of the new technology will eventually occur and have significant impacts on education. Despite this, teacher trainers believe that the human factor will continue to play a crucial role in education and that AI will simply be another tool to help students progress. Teachers' perspectives on the tool differ, with most seeing benefits in enhancing personalized learning. However teacher trainers also worry that, without proper precautions, AI will lead to a decrease in critical thinking skills among students.

During the preparation of this work, I used ChatGPT in order to research its use cases in AIED and provide help with academic formatting. After using this tool, I reviewed and edited the content as needed and take full responsibility for the content of the work.

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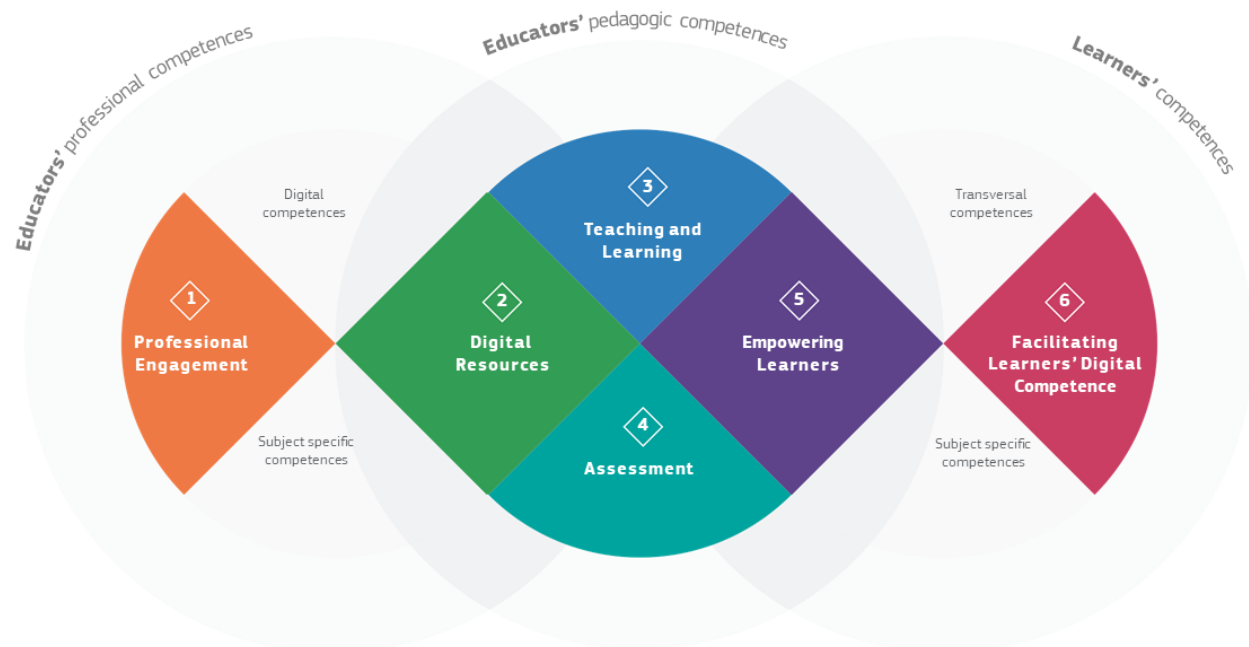
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<https://doi.org/10.21037/jmai-23-36>

## 7. Annex

### Annex A: Digital competencies for educators

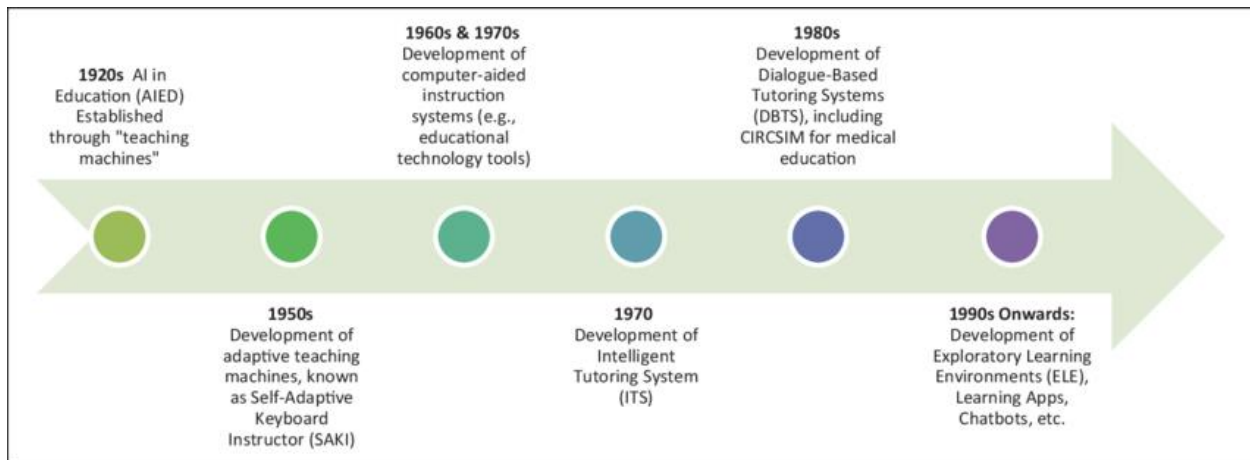




## Annex B: 6 areas of SELFIE for teachers tool



## Annex C: Timeline of AIED integrations



## Annex D: EU AI act policies

High-risk AI systems will be subject to strict obligations before they can be put on the market:

- adequate risk assessment and mitigation systems;
- high quality of the datasets feeding the system to minimise risks and discriminatory outcomes;
- logging of activity to ensure traceability of results;
- detailed documentation providing all information necessary on the system and its purpose for authorities to assess its compliance;
- clear and adequate information to the deployer;
- appropriate human oversight measures to minimise risk;
- high level of robustness, security and accuracy.

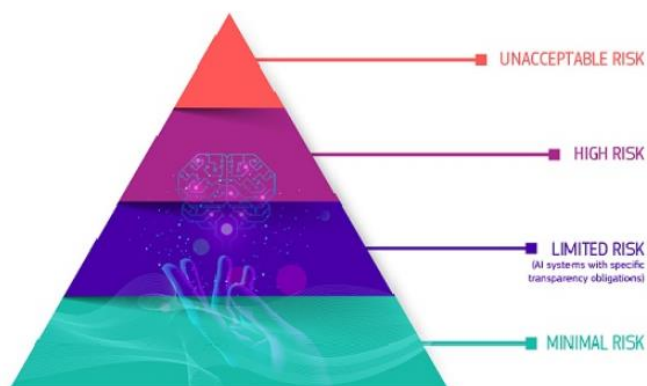
All remote biometric identification systems are considered high-risk and subject to strict requirements. The use of remote biometric identification in publicly accessible spaces for law enforcement purposes is, in principle, prohibited.

Narrow exceptions are strictly defined and regulated, such as when necessary to search for a missing child, to prevent a specific and imminent terrorist threat or to detect, locate, identify or prosecute a perpetrator or suspect of a serious criminal offence.

Those usages is subject to authorisation by a judicial or other independent body and to appropriate limits in time, geographic reach and the data bases searched.

## A risk-based approach

The Regulatory Framework defines 4 levels of risk for AI systems:



All AI systems considered a clear threat to the safety, livelihoods and rights of people will be banned, from social scoring by governments to toys using voice assistance that encourages dangerous behaviour.



## Annex E: Digital copy of Informed consent form

### Informed Consent Form

Institutions: University of Twente

Interviewee (Title and Name): \_\_\_\_\_

Interviewer: Elias Eichler, bachelor's student at the University of Twente.

Survey Section Used:

- Institutional Perspective
- Teaching and Learning

Other Topics Discussed: Perspectives on usage of new technologies in education, familiarity with technologies such as Large Language Models (LLMs), Unified theory of Acceptance, DigCompEU framework

Documents Obtained: Informed consent form, copy of the questionnaire

|

#### Teaching, Learning, and Assessment Interviews

##### Introductory Protocol

To facilitate our note-taking, we would like to audio tape our conversations today. Please sign the release form. For your information, only researchers on the project will be privy to the tapes which will be eventually destroyed after they are transcribed. In addition, you must sign a form devised to meet our human subject requirements. Essentially, this document states that: (1) all information will be held confidential, (2) your participation is voluntary and you may stop at any time if you feel uncomfortable, and (3) we do not intend to inflict any harm. Thank you for your agreeing to participate.

We have planned this interview to last no longer than forty-five minutes. During this time, we have several questions that we would like to cover. If time runs short, it may be necessary to interrupt you to complete this line of questioning.

##### Introduction

You have been selected to speak with us today because you have been identified as someone who has a great deal to share about teaching, learning, and assessment, as well as being qualified to answer questions on your perception on the integration of new technologies in education. Our research project focuses on the improvement of teaching, learning, and structural activity, with particular interest in the integration of Artificial Intelligence using Natural Language in education. We are trying to learn more about your perceptions on this new technology on teaching and learning, and hopefully learn about faculty practices that help enforce the implementation of new technologies.

UNIVERSITY OF TWENTE.

## Consent Form for Semi-structured interviews on AIED

YOU WILL BE GIVEN A COPY OF THIS INFORMED CONSENT FORM

*Please tick the appropriate boxes*

Yes No

### Taking part in the study

I have read and understood the study information dated [14/04/2024], or it has been read to me. I have been able to ask questions about the study and my questions have been answered to my satisfaction.

I consent voluntarily to be a participant in this study and understand that I can refuse to answer questions and I can withdraw from the study at any time, without having to give a reason.

I understand that taking part in the study involves answering questions about the integration of Natural Language AI to the best of my ability, as well as consenting to the anonymous use of my data for further research. The information will be audio-recorded and transcribed, all recordings will be deleted once the analysis of the data is completed.

### Use of the information in the study

I understand that information I provide will be used for research conducted by the University of Twente.

I understand that personal information collected about me that can identify me, such as [e.g. my name or where I live], will not be shared beyond the study team.

I agree to be audio recorded. Yes/no.

### Future use and reuse of the information by others

I give permission for the responses that I provide to be archived in the Utwente Repository so it can be used for future research and learning. Only anonymised transcripts of the interviews will be stored.

I agree that my information may be shared with other researchers for future research studies that may be similar to this study. The information shared with other researchers will not include any information that can directly identify me. Researchers will not contact me for additional permission to use this information. (Note: This separate consent is not necessary if you will only store and share deidentified data.)

I give the researchers permission to keep my contact information and to contact me for future research projects.

UNIVERSITY OF TWENTE.

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**Signatures**

_____	_____	_____
Name of participant [printed]	Signature	Date

I have accurately read out the information sheet to the potential participant and, to the best of my ability, ensured that the participant understands to what they are freely consenting.

_____	_____	_____
Researcher name [printed]	Signature	Date

**Study contact details for further information:** Elias Eichler, [e.eichler@student.utwente.nl](mailto:e.eichler@student.utwente.nl)

**Contact Information for Questions about Your Rights as a Research Participant**

If you have questions about your rights as a research participant, or wish to obtain information, ask questions, or discuss any concerns about this study with someone other than the researcher(s), please contact the Secretary of the Ethics Committee/domain Humanities & Social Sciences of the Faculty of Behavioural, Management and Social Sciences at the University of Twente by [ethicscommittee-hss@utwente.nl](mailto:ethicscommittee-hss@utwente.nl)

Post Interview Comments or Leads:

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## Annex F: Questionnaire

Questionnaire:

Introduction Questions:

1. How long have you been teaching?
2. What is your highest title/teaching diploma?
3. What is your field of teaching?

Background information:

1. How familiar are you with current Natural language AI tools?
2. How confident do you feel using AI tools for personal use?
3. Do you think that AI tools are useful for teachers?
  - a. Do you think they are useful for your students?

Section 1:

Teaching and learning

1. To what extent would you consider yourself to use AI technologies to design, develop and support learning as a teacher?

Self-regulated learning

2. To what extent would you encourage students to use natural language AI to foster active and self-regulated learning?
  - a. Do you have any concerns with such encouragement?
  - b. What should be different for you to be freer in your usage?

Section 2:

Searching and selecting

1. Are you able to find AIs that helps you in teaching and learning?
  - a. Do you show this to teachers you educate?
  - b. If you find options, how would you select an appropriate tool?
  - c. How often do you perceive students using it?
  - d. Are you satisfied with your current usage?

Creating and content creation



2. To what extent do you use AI to create digital resources that support and enhance teaching and learning aims? (simplify) (for example, images, text etc.)
  - a. Would you like to learn how to implement these resources more effectively?
  - b. Is this something that you encourage your students to do?
  
3. How often do your students (other teachers) use AI to create digital resources for classes?
  - a. Would you encourage such use, why/why not?
  - b. Would you want the students of teachers to learn to use such resources?

#### Information and data literacy

4. If applicable, how do you incorporate learning activities which require learners to use AI to search evaluate and manage information and data in digital environments? (if preservice, would you suggest this for your students)
  - a. To what extent would you want to incorporate this into your classroom?
  - b. Do you think it is important to teach this skill?

#### Safety and wellbeing, responsible use

5. Can you support your students in using AI without hurting their physical, psychological and social well-being?
  - a. Do you believe such resources can be used safely?
  - b. Do you think your students would use it responsibly in their career?
  
6. What potential outcomes do you believe AI usage could have on educational development?
  
  
7. Do you see any ethical issues in using such AI driven technologies?
  - c. How would you prevent these issues from impacting educational settings?
  - a. What could further responsible use applications?
  
8. To what extent do you encourage learners to use AI responsibly and manage their digital identity?
  - a. Do you think this should be taught at secondary education levels?

- b. How would you implement such education?

### Section 3:

#### Organizational communication

1. To what extent would you use AI to enhance and/or automate communication with colleagues and/or learners and/or parents?
  - a. Would you consider such options in the future? Why/why not
  - b. What are your perceptions of other people using these technologies for such purposes?

#### Professional Collaboration

2. How much would you use AI to collaborate and interact with colleagues and/or other education stakeholders?
  - a. Would you be willing to teach colleagues to interact with these technologies?
  - b. Are there any such cases already existent at your school?

#### Digital technologies and school level infrastructure

3. How much do you use AI and infrastructure available in your school to teach AI usage? (if preservice, guide)
  - a. Would you like to make use of these technologies more or less often?

#### Reflective practice

4. Would you allow your students to use AI tools, and then reflect on their usage?
  - a. Should they do this when teaching in secondary education?
  - b. Why/why not?

#### Digital life

5. To what extent do you contribute to positively and ethically handling AI usage amongst students and fellow educators? (if preservice, whether they could contribute to such discussions)
6. Have you ever engaged in professional learning activities for the development of teachers' AI knowledge?
  - c. What was mentioned about AI in education?
  - d. What was your takeaway from the experience?

### Professional learning

4. To what extent do you use AI tools for your own professional learning?

### Accessibility and Inclusion

7. Do schools across the Netherlands have sufficient access to digital resources to make use of AI technologies?
  - a. How big is the disparity between schools?

### Actively engaging users

8. Have you used AI to foster learners active and creative engagement in their learning? Why/Why not?
  - e. If applicable, how did the experience go?
  - f. Should teachers let their students use these tools independently to advance in their class? Why/why not?

### Blended learning

9. If any, in what aspects would let students use AI in online learning environments and platforms to ensure students learn within and beyond the classroom?
  - a. How should teachers encourage this usage?

## Annex G: Full table analysis

Table 1: Themes related to personal perceptions

Code	Frequency	Example
Experience with AI tools	8/8	I use it for getting ideas. For instance, I know I have a certain subject and I want to know an example of or it's chemistry, so we do practical work. Get a practical exercise or maybe theoretical exercise just to get ideas. - Transcript 3
Familiarity with AI	8/8	I know some things about AI, but because I don't know all the possibilities, it's difficult for me to say, oh, it has to look like that. I did the hackathon AI, and what I heard about that, it all shapes how you think about AI. - Transcript 4
Job displacement	1/8	And, but the danger is not, it is less in the tool itself. The danger is more in that people will still have their education... But it's still, not AI, it's still... I think the bad apples will come to the surface. -Transcript 5
Potential benefit	8/8	And then you can definitely use AI in secondary education to help them along with any kind of project to get ideas, to teach them how to ask the right questions towards AI, not just simply repeat the question that they got and see what comes out of it, but then follow-up questions like can you include this, et cetera. And I think in that sense they can learn a lot. And when it comes to, for example, the methods that they use in high school

with the books and the online, I think there is a lot of AI that can be implemented so that the students get the right kind of questions back.

-Transcript 1

Risks and concerns

8/8

And if you don't know how to self-regulate yourself, following a program, well, yeah, maybe it works, maybe it doesn't. You don't know. So it won't help you to get yourself in a better self-regulation. -Transcript 3

Because if you think GPT is right and you directly use it, then that would be a very big problem.

Transcript 4

Perceptions of AI usage by other teachers

8/8

For my school, there is no policy how to use or how to not use generative AI. Okay. So every teacher does as he or she pleases.

-Transcript 3

Perceptions of AI usage by students

7/8

But I'm also talking to other teachers at secondary school and they are complaining that, yeah, okay, that the students. There is a lot of usage.

-Transcript 6

Perceptions on collaborative use

8/8

And I prefer human conversation but I also see that sometimes it may take time if you have automatic response. I still would prefer that you only use it as suggestions and then look at it. I don't like the idea that you only get answers from a chatbot without human interference.

-Transcript 2

Perceived  
impact of AI in  
education

8/8

[Researcher]

Would you want the students of the teachers that you educate to learn to use such resources?

[Teacher]

Sorry, you can't stop that. Nothing about me to want it or not want it.

-Transcript 8

I really think that everybody has to learn to use them in a responsible way. We already talked about how to educate your students, so I think they also should be able to look at the responsibility, but also the freedom to do so.

-Transcript 2

Professional  
development

8/8

Yeah, knowledge of ethical use. At my school and at most schools, there is not such a program yet. So we are convinced it's very important and we have no idea how to implement it.

-Transcript 3

Yes, I think we have a task here as educators and especially as teacher-educators.

-Transcript 2

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*Table 2: Themes related to teacher educator perspectives*

<b>Code</b>	<b>Frequency</b>	<b>Quote</b>
Educational Equipment	7/8	<p>If one or more teachers acting at that school, teaching at that school, if they are open for these technologies, then it is not a problem for the school to introduce these technologies. The money is in fact no problem and they will support it, but the problem is they do not have experts. The teachers are so busy.</p> <p>-Transcript 6</p>
Effects on social wellbeing	4/8	<p>There are all these things and risks that we probably don't even know what risk is. And there's probably something that can be very harmful for their psychological health. So, yeah, probably if you're in a depression and you ask the wrong questions, you would even become more depressive or something like that.</p> <p>So I'm not, no, I don't think it's a harmless tool. I think you should really know what to do. -Transcript 8</p>
Involvement in professional learning activities	6/8	<p>Well, what we did, we developed an AI tool, or at least we had an idea what we wanted in the end. An AI tool to enhance learning. In this case, it was the chemistry bit of conceptual thinking. (Last years AIED Hackathon) - Transcript 3</p>
Lack of Knowledge on AI uses	6/8	<p>I don't know, because also I don't know everything about it. So, we're also doing something, and I'm not sure if I'm</p>

doing the right thing. So, yeah, it will be a matter of time to know if it's good or not.

-Transcript 4

Educator  
Encouragement 8/8

I also, yeah, definitely. I used it to just make whole problems for problem solving in physics. Even to give a student some ideas of what research questions he could ask because he came with a vague theme where he wanted to do research on.

-Transcript 5

And I wanted to help him to make it more concrete. I just asked him, do you have some research questions in this area? And that helped.

-Transcript 8

Teachers  
motivation to use  
AI 7/8

Yes, I know that with programming education they are looking at how to give feedback on code construction. They are also even looking at correcting tasks with AI. It depends if you really have a lot of tasks, much work, which all is the same, then you can automate it, I think.  
Transcript 2

Professional  
development 8/8

You cannot keep it away you have to be aware of it I think and you have to make the pupils and people aware of it and be responsible in it... so inform people.

Transcript 5



Personal use	8/8	Only just for ideas or inspiration for articles. To write some nice beginning of an article. Catchy one or something. -Transcript 5
Familiarity with AI	8/8	Only ChatGPT. I use sometimes myself. -Transcript 5  Simply taking into account that AI is a simple production of knowledge, factual knowledge, procedural, and that's it. It's by especially academic and psychological in some of those. -Transcript 7
Lack of need to use AI tools	7/8	Yeah, or too early in what we or they themselves taught them about these programs. It's not common in secondary school to encourage using AI. Not at all. - Transcript 3
Lack of trust in AI tools	5/8	Then it must be more reliable. Then I have to trust that what it says also based on Brommen that it's true that it's an existing source, and that cannot be said currently. -Transcript 5

*Table 3: Themes about Teaching and Learning*

<b>Code</b>	<b>Frequency</b>	<b>Example</b>
Effect on student engagement	8/8	And in secondary education, there's the bigger problem, I think, that for students it's harder to take that step and be like, well, I have a question, I have an answer, that for them often more or less feels like, okay, then

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Ethical/responsible use

8/8

I'm done. And that shouldn't be the case. So that's where I think that for students, I think it's very important to not forbid them.

-Transcript 1

Yes. This has to do with data storage, especially when using large systems like JPT, it learns on its user's input. So there's a lot of concern with having your digital identity essentially stored by the questions that you ask it. -Transcript 6

But just make sure that when you use AI, that first you keep a registry of what questions you're asking and how you're using the results to provide answers for us in the exercise that we give them, that they need to hand in, because otherwise you get plagiarism, some sort of.

-Transcript 1

Potential impact on education	8/8	<p>Yeah I think the world is changing so also the education is changing but I think on the basic ground there will be contact between humans. Yeah so you would say despite the despite more AI usage you will still have a similar need for a human interaction for educational purposes. And of course I also see now on the books we use and this online thing that when a pupil said some answer then the online environment reacts with think about this or it's not all okay so think about this.</p> <p>-Transcript 5</p>
Personalized feedback and learning	3/8	<p>For these students, it's not really, but maybe for students in high school or secondary education. What they could do is putting in a chapter and then can you make some example questions for the test and so they can check their self. Maybe they can use it like that.</p> <p>- Transcript 4</p>
Need for reflective use by students	7/8	<p>They are critical on the information they get. And that was the solution for Wikipedia. That's the solution for AIs well. And, um,</p>

there's only one way to, to learn them, to confront them with the mistakes.

-Transcript 7

Impact on secondary education 7/8

Instead of generating sometimes it is nicer to just make something for yourself. Okay. So this is also sometimes when you would not encourage your students to do so or would not like want to have teachers educate your students about this because you don't want the students to lose that individual impact they could have in their writing.

-Transcript 5

Implementation in Teaching Practices 8/8

We use it in the lessons. They all have iPads.

-Transcript 3

It's not a whole course. But at the moment we have an assessment where students are asked to look at an IT tool and present it.

And I think about asking them to look for an AI tool to present. -Transcript 2

Current AI teachings 5/8

I think if we agree on how, for instance, university level or school level or whatever level. If there's really a policy that is shared by everyone, then I think it should be more detailed. Okay.

But at the moment, most of these instances don't have this policy. -Transcript 3

Wanted implementations 8/8

I think we have to deal with it. If you have a big group of students, you never know if they all have the same moral compass. So I think you should say in the beginning clearly to what extent you allow them to use AI and for what things and what things not.

-Transcript 8

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