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TEACHER PERCEPTIONS OF AIED:

Exploring Future Scenarios in Secondary Education

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Supervisor:	Marisa Ponti
Examiner:	Malin Nilsen

Abstract

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Purpose: This thesis investigates the integration of Artificial Intelligence (AI) in secondary education by examining educator perceptions, with the aim to understand how AI might either support or complicate educational practices. It explores potential trajectories, both optimistic and pessimistic, regarding AI's role in enhancing educational productivity and transforming teacher-student dynamics.

Theory: This thesis is based on the Social Construction of Technology (SCOT) framework, with a focus on the concept of interpretive flexibility, a key aspect of SCOT (Pinch & Bijker, 1984). Specifically, I draw on the work of Doherty, Coombs, & Loan-Clarke (2006), who redefine interpretive flexibility by considering both the technology's capacity to accommodate different perspectives and the stakeholders' initial interpretations of the technology's capabilities. Users then utilize and adapt the technology, allowing for these different interpretations to be expressed and maintained. As a result, interpretive flexibility suggests that technology can be understood and employed in various ways, underscoring the influence of social processes in shaping technological tools (Doherty, Coombs, & Loan-Clarke, 2006). In this research, interpretive flexibility serves as a framework to explore how AI technologies might either enable or limit teachers' abilities to interpret and utilize these tools within diverse and often conflicting educational and social contexts. This concept sheds light on the differing views of AI among teachers, shaped by their unique experiences, values, and the specific educational settings in which they operate. Understanding the full impact of AI in education on productivity and teacher skills requires acknowledging that AI can both support and constrain various interpretations and meanings.

Method: The research methodology combines speculative design with empirical qualitative analysis. Future scenarios – both optimistic and pessimistic – were crafted based on extensive literature review and existing theoretical frameworks. These scenarios were employed as narrative tools in semi-structured interviews with secondary education teachers to elicit their perceptions, concerns and hopes regarding the integration of AI in education. This approach allows for an in-depth exploration of the potential impacts of AI from the educators' viewpoints.

Results: The findings reveal a dual perspective among educators. On the positive side, AI is seen as having the potential to significantly reduce teacher workload, personalize learning experiences, and enhance administrative efficiency, potentially boosting educational productivity by allowing teachers more time for direct instruction and student

engagement. However, concerns are significant regarding ethical implications, potential increases in educational inequity, and the erosion of teacher autonomy. Educators are particularly wary of AI-driven approaches that prioritize efficiency and standardization, fearing these could undermine the depth of learning and critical engagement essential in education. The study underscores the complexity of how AI could influence educational productivity, highlighting the need for metrics that recognize deeper learning and critical thinking over simplistic output efficiency. This emphasizes the necessity for a balanced approach that includes ethical considerations, teacher involvement in AI tool development, and ongoing policy support to ensure AI enhances rather than undermines educational goals.

Foreword

As I conclude this significant phase of my academic journey with the completion of my master's thesis, it is imperative to acknowledge those who have been instrumental in my academic and personal growth. This thesis, while an individual accomplishment, is a testament to the collective support and inspiration provided by many incredible individuals in my life.

Firstly, I extend my deepest gratitude to Marisa Ponti, my supervisor during my internship and the writing of this thesis. Marisa has been more than a supervisor; she has been a guidepost and a mentor who provided me with invaluable opportunities to expand my horizons and accomplish more than I had imagined. Her guidance and insights have profoundly shaped my approach to research and learning, for which I am eternally grateful.

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To my classmates in this program, thank you for the friendship, support, and rich exchange of ideas. You have made this academic journey immensely rewarding and enjoyable. Your confidence in me as a student and thinker has been a cornerstone of my own confidence, helping me navigate through moments of self-doubt and insecurity. Your camaraderie has been one of the highlights of my studies and I cherish the memories we have made together.

A special thanks to my family and friends across the ocean. Despite the physical distance, your belief in my capabilities has been unwavering. Your constant reminders of what I am capable of achieving and your pride in my accomplishments have been a source of motivation and strength. You have all contributed to this journey in ways that words cannot fully capture.

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This forward is a small gesture to express my appreciation to each one of you. Your support has been a beacon of light throughout this educational pursuit, illuminating my path towards growth and knowledge. Thank you for being a part of my journey.

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1. Introduction

In the current educational system, we confront a profound uncertainty about the future, especially as Artificial Intelligence (AI) applications become increasingly integrated into educational contexts. This uncertainty is not merely a challenge to be mitigated, but a fundamental characteristic of digital education today. As Ross (2017) articulates, the “not-yetness” of digital education encompasses the complexity, uncertainty, and risk inherent in emerging technologies. These are conditions of radical and enduring unpredictability where traditional approaches to educational research, focused on determining ‘what works,’ may fall short. Instead, there is a compelling need for approaches that engage in ‘intelligent problem solving’ and ‘inventive problem-making,’ which can embrace the unknown and flux of digital technologies in educational settings (Biesta, 2010; Michael, 2012).

The integration of AI in education exemplifies this not-yetness. In the current era of AI, there are no single technologies driving the surge, but rather advances in machine learning, natural language processing, and big data coupled with enormous computing power. These are not mere tools, but ideas filled with evolving public imaginaries, making ethical dimensions of AI particularly complex and far-reaching. Therefore, there is an urgent need for broader engagement with the ethical and practical issues raised by AI in education (AIED), extending beyond technologists to include educators, policymakers, and the wider community. A plausible route to encourage this critical engagement is through the use of design fiction – a method that uses fictional scenarios to provoke thought and discussion about the potential societal impacts of new technologies (Cox et al., 2022; Inyatullah, 2013; Ross, 2017).

Against this backdrop, this thesis utilizes future scenarios to explore the potential trajectories of AIED. These scenarios, both optimistic and pessimistic, are crafted as both speculative exercises and a strategic tool to elicit and understand teacher perceptions on integrating AI in educational practices. This approach is informed by a literature review that highlights the multifaceted impacts of AI on educational productivity, teacher competencies, and workload, setting the stage for a nuanced examination of AI’s potential roles in educational settings. Educational productivity, traditionally measured through simplistic input-output models by many governmental bodies, often fails to capture the complex outcomes of education such as student engagement, cognitive development, and emotional growth (Hanushek & Ettema, 2017). Despite the limitations of this measurement approach, it remains a common framework used by policy makers to assess the efficacy of educational systems, primarily through metrics like test scores and graduation rates (Bureau of Labor Statistics, 2014; Hanushek & Ettema, 2017; NCES, 2023; Skolverket, 2023). For consistency with these prevalent governmental practices, this thesis will also reference educational productivity in this simplified economic sense – where inputs include time, resources, and funding, and outputs are primarily measured by student learning outcomes.

AIED holds the promise to significantly enhance this form of educational productivity. By automating routine tasks, personalizing learning experiences, and providing data-driven insights, AI could potentially transform educational environments, making them more adaptive and responsive to the needs of students and teachers alike (Holmes, et al., 2022; Tuomi et al., 2023). However, the deployment of AI technologies in education is fraught with challenges, including resistance from educators due to mismatches between AI tools and curriculum demands, ethical concerns, and fears of diminishing teacher autonomy (Kizilcec, 2023; Puttick et al., 2015).

This thesis, therefore, seeks to probe deeper into these complexities by analyzing how teachers perceive and interact with AI technologies. Using the created future scenarios as a narrative tool during interviews, this study aims to gather rich insights into the practical and philosophical concerns that educators have regarding AI. These scenarios serve as a concrete means to discuss potential futures in education, helping to illuminate how teachers might navigate the uncertain terrains shaped by AI advancements.

Ultimately, this research aims to contribute to a more robust understanding of how AI could be strategically implemented to enhance educational productivity while aligning with the values and needs of educators. By exploring the intersection of AI's potential, educational productivity and teacher perception, this study aspires to provide meaningful insights that can inform the development of AI tools that are effective and broadly accepted and beneficial within the educational community.

The work of teachers and school leaders is an ongoing issue for education systems on a global scale (Creagh et al., 2022, p. 1). AI in Education (AIEd) is frequently cited as a way to improve education by increasing economic efficiency through personalized learning and the redistribution of teacher time, aligning with the educational industry's focus on innovative solutions to enhance teaching practices and learning outcomes. For example, Chaudhry and Kazim (2021) highlighted research in AIEd, emphasizing its potential to reduce teachers' workload and provide contextualized learning for students. However, this focus on efficiency may not always align with teachers' perceptions and experiences. Teachers may have concerns about the practical implementation of AIEd, its impact on their workload, and its effectiveness in addressing the specific needs of their students. They might also be skeptical about how well these technologies integrate into existing educational practices and whether they truly enhance the learning environment or inadvertently introduce new challenges. Given these potential concerns and uncertainties, it is crucial to investigate this research question:

In what ways do teachers perceive as being impacted by AI technologies in secondary education, in terms of their productivity and workload?

Since educators play a crucial role in the education ecosystem and have unique insights into the practical implications of the integration of technologies in their practices, I chose to focus on them. As part of this study, I aim to navigate the not-yet nature of AIEd, utilizing a research approach that acknowledges and engages with the multifaceted nature of the issues surrounding the integration of AI technologies in education. By fostering a dialogic and inclusive exploration of future educational landscapes with teachers, I can gain a deeper understanding of the real-world impact of AIEd and develop strategies that align technological advancements with the nuanced needs of the educational community.

To address this question and explore the multifaceted impacts of AIEd, this thesis is structured as follows: a literature review detailing the current state and potential impacts of AI on educational productivity and teacher workload. This is followed by an exploration of the theoretical framework that guides the study and the methodology section which describes the process of developing future scenarios and the methods used to collect and analyze data from interviews with educators. This is followed by the findings section, which presents the insights gathered from the interviews, highlighting educators' hopes, concerns, and the perceived implications of AIEd. The discussion section interprets these findings, drawing connections between the theoretical perspectives, the data collected, and the broader implications for policy and practice. This structure aims to provide a clear, coherent narrative that bridges theory with practical insights, fostering a deeper understanding of how AI can be harnessed to enhance educational outcomes in a way that is ethical, effective and inclusive.

2. Effects of AI on productivity and workload in education in secondary education: a brief narrative literature review

To provide a background to this study and guide the development of the scenarios I will present later, this brief narrative literature review (see Appendix A) examines the integration of AI in education, with particular focus on its impact on educational productivity and the organization of teacher work, specifically workload and administrative efficiency. This review explores how AI technologies can potentially transform educational environments by automating routine tasks, personalizing learning experiences, and providing data-driven insights. Key themes explored include the new skills required by educators and the influence of AIED on personalized learning.

This review directly ties to the thesis's goal of exploring educators' perceptions and finding interventions that maximize AIED's benefits and reducing risks. The inclusion of teachers' insights is essential for developing practices that enhance educational productivity. As UNESCO recommends, teachers should be largely responsible for guiding the use of AI in classrooms, ensuring that it adheres to pedagogical goals and is appropriate for contexts and cultures that vary greatly within and across countries (UNESCO, 2024).

2.1 AI in education: What is it and how is it used?

AIED is a multifaceted domain that incorporates various AI technologies to enhance the learning experience and improve educational practices. The field of AIED has evolved from primarily relying on knowledge-based AI to incorporating more advanced, data-driven AI, including machine learning approaches. These advancements have brought about significant changes in how AI is applied in education.

Initially, AIED was characterized by knowledge-based systems, where human experts had to define domain knowledge explicitly. This approach was particularly evident in intelligent tutoring systems (ITS), which provided personalized learning experiences through individualized content sequencing and spacing (Tuomi et al., 2023). However, the rapid advancements in data-driven AI have expanded the scope of AIED, introducing tools like generative AI, large language models (like Google's BERT and OpenAI's GPT-4), and dialog-based systems (such as ChatGPT and Microsoft's Bing Chat) (Tuomi et al., 2023). These systems have significantly enhanced the capability of AIED tools to interact with users in more sophisticated and adaptive ways.

AIED is employed in various educational contexts, ranging from direct learner support to aiding teachers and administrative systems. It includes systems for personalized learning, automatic writing evaluation, learning analytics, chatbots, and tools to support learners with disabilities. AI is also used to streamline administrative tasks like recruitment, timetabling, and learning management (Holmes et al., 2022). Despite its growing use in classrooms worldwide, the efficacy of learner-supporting AI tools, especially in well-resourced settings, remains a subject of debate, with some studies calling for more robust, independent evidence to justify their widespread adoption (Holmes et al., 2022).

Interestingly, AIED's application is not limited to supporting students but extends to assisting educators. Recent research has focused on developing AI tools for resource curation, teacher practice analysis, time management, and course planning. However, the adoption of these technologies by commercial players and their widespread availability remains limited (Holmes et al., 2022). Despite the potential of AI to automate routine tasks, it is widely acknowledged that AI cannot replace the essential role of teachers (Holmes et al., 2022; Richter et al., 2019; Tuomi et al., 2023; UNESCO, 2019). The human mentorship aspect of teaching, along with the creative and socio-emotional elements, is beyond the scope of AI capabilities. Therefore, the development and integration of AI tools in education must be a participatory process, designed to support teachers rather than replace them (UNESCO, 2019).

The role of AI in education is not just about supporting current educational practices but also about transforming how learning is approached. AIED systems can construct adaptive and personalized learning experiences, making computational inferences that assist teachers in understanding optimal learning processes (Lameras & Arnab, 2022). This transformation aligns with the broader educational trend of moving from traditional didactic teaching to facilitating independent and collaborative learning (Roll & Wylie, 2016). In summary, AIED represents a significant shift in educational technology, offering tools that personalize and enhance learning experiences. While its potential to revolutionize education is considerable, the effective integration of AI in education requires a careful balance between leveraging technological advancements and maintaining the human-centric aspects of teaching and learning. AIED, therefore, stands not as a replacement for traditional educational methods, but as a powerful complement that can enrich and diversify the educational landscape.

Next, the review will delve into how AIED could affect teacher competencies and personalized learning, which are crucial aspects of the educational landscape.

2.2 Productivity in education: How is it defined and where does it come from?

The integration of AIED necessitates the development of new teacher competencies, particularly in understanding and utilizing AI tools effectively. According to Lameras & Arnab (2022), AI can be understood in various ways, often creating confusion among educators regarding its application and potential impact. The competencies required include both technical skills, such as understanding machine learning and neural networks, and pedagogical skills, like designing AI-enhanced learning activities that are adaptive to individual student needs (Lameras & Arnab, 2022; Velandar et al., 2024). Therefore, to successfully implement AIED, teachers need to develop a robust set of digital competencies. This includes skills in data analysis, understanding AI algorithms, and leveraging AI tools for personalized learning (Velandar et al., 2024). The European Union's DigiCompEdu framework outlines key competencies, such as information literacy, content creation, and collaborative learning, which are essential for integrating AI into teaching (Redecker & Punie, 2017). However, teachers often have misconceptions about AI, viewing it as more advanced or autonomous than it currently is, which can lead to anxiety and resistance to using AI tools (Velandar et al., 2024).

Overcoming these misconceptions through targeted professional development (TPD) that focuses on the realistic capabilities and limitations of AI is crucial. Such training should also emphasize the relationship between existing digital skills, like programming and computational thinking, and AI applications (Lameras & Arnab, 2022; Velandar et al., 2024). The development of these competencies for teachers would enhance AIED's potential for personalized learning by tailoring educational content and experiences to individual student needs. Lameras & Arnab (2022) describe how AI systems can collect, analyze, and represent data to achieve complex educational goals, providing adaptive and personalized learning experiences. AI systems, like ITS and adaptive learning platforms, can adjust the difficulty and type of content based on a student's performance and learning style. This allows for a more customized educational experience that can address the unique needs and preferences of each student (Lameras & Arnab, 2022). Additionally, AI can provide scaffolded support, helping students to engage with content at their own pace and level. For example, adaptive learning systems can offer immediate feedback and suggest next steps based on a student's progress, thereby facilitating a more personalized learning journey (Lameras & Arnab, 2022).

Though, the impact of personalized learning through AI on teachers' workload is multifaceted. The use of AI-powered platforms can help teachers tailor educational materials and activities to individual students' needs, reducing the time they spend preparing differentiated instruction, thus lessening their workload (Hardinson, 2022; McShane, 2022). However, the process of integrating and learning to use new AI tools can initially increase a teacher's workload, requiring additional time for professional development and familiarization (Hanushek & Ettema, 2017; Pham & Sampson, 2022). In the long run,

AI has the potential to decrease workload by allowing teachers to focus more on facilitating personalized learning and fostering meaningful student relationships, despite the initial increase in demands.

Therefore, the integration of AIED can bring about new developments in teacher competencies, personalized learning, and student engagement. Educators can effectively utilize AI tools to create more adaptive, personalized and engaging learning experiences by developing the necessary digital competencies. Addressing misconceptions about AI through professional development and emphasizing realistic capabilities and benefits of AI are crucial steps in this process. As AI changes and evolves, its role in education will likely expand, offering new opportunities and challenges in teaching and learning.

Moving forward, the review will examine how AIED can affect educational productivity and teacher workload, providing a comprehensive understanding of its impact on the educational system.

2.3 How can AI affect productivity in education?

AIED has the potential to significantly influence educational productivity, particularly concerning teacher workload, time management, and administrative efficiency. Educational productivity measures the outputs of the education system in relation to the inputs utilized (Hanushek & Ettema, 2017). Inputs include resources such as labor, time, and materials, while outputs encompass student learning outcomes like test scores and graduation rates (Hanushek & Ettema, 2017). Educational productivity is closely related to work organization, which refers here to the amount of work and administrative burdens placed on teachers (Gavin & McGrath-Champ, 2023), which in turn are determined by financial resources allocated. Firstly, it is important to acknowledge the existing inefficiencies in education.

Increasing teacher workload is a global concern (Creagh et al., 2022; Stacey et al., 2023). The productivity of teachers and their workloads have an obvious relationship. Teacher workload is usually defined “as the amount of work done over a given period” (Creagh et al. 2022, p. 3) Work tasks reported by teachers in survey data include both “core” tasks such as teaching, and non-core educational work such as administration (Creagh et al., 2022). It has been recognized that teacher workloads are excessive and intensive, and the negative effects of an unrealistic workload have a considerable impact on teaching quality, teacher work life, and student learning outcomes (Stacey et al., 2023). In fact, as noted by Hanushek & Ettema (2017), despite increased spending, mostly driven by higher labor costs and reduced class sizes, there has not been a corresponding rise in student outcomes. This disconnect between inputs (resources like labor and money) and outputs (measurable educational achievements) highlights a decline in educational productivity (Hanushek & Ettema, 2017). Even with increased resources, the educational sector has apparently not fully tapped the efficiencies offered by technological advancements, including AI.

Some perspectives assert the potential for digital technologies and artificial intelligence tools (e.g., ChatGPT) to enable teachers to work more efficiently and effectively by reducing repetitive tasks, facilitating automation and standardization (e.g., automatic grading, templated lesson plans, drafting emails), and easing workload burdens (Alirezabeigi et al., 2020; Selwyn, 2020). These tools can allow teachers to focus on higher-order activities, such as tailoring their classrooms to the individual needs of their students, which is arguably their core work. Uygun (2024) supports this view, noting that many teachers perceive AI as a valuable supplementary tool for enhancing education, improving productivity, and aiding in tracking the learning process. However, more critical perspectives draw attention to how technologies may deskill teachers’ work or make their work more complex and challenging (Newhouse, 2014; Selwyn et al., 2017; Stacey et al., 2023).

AIED is expected to address these inefficiencies by automating routine tasks and supporting teachers in non-instructional duties. For example, McShane (2022) illustrates that teachers dedicate significant time to planning, administrative tasks, and communication with parents. AIED can streamline these processes, reducing the time teachers spend on non-teaching activities, as detailed in the survey by Hardinson

(2022). By automating grading and providing feedback on student work, AI systems can free up substantial amounts of a teacher's workweek, allowing them to focus more on direct student engagement and personalized instruction. Additionally, AIED is expected to contribute to a more efficient allocation of educational resources. Hanushek & Ettema (2017) argue that simply providing more resources without changing how they are used does not consistently raise student outcomes. AIED can optimize the use of these resources by enhancing teacher effectiveness and enabling personalized learning experiences for students. By supporting teachers with AI-driven tools for lesson planning, content delivery, and student assessment, AIED can help shift the focus from quantity to quality in resource utilization.

Despite the optimistic outlook, Uygun (2024) highlights several concerns among teachers regarding the use of AI in education, including fears of creating a sterile emotional environment, threats to security and privacy, and the potential to render individuals passive. Teachers also express reservations about the impact of AI on their roles, ethical considerations, and the potential to undermine the development of an inquisitive mindset. These concerns reflect the broader challenges of integrating AIED, as noted by Pham & Sampson (2022), who emphasize that the adoption of AIED involves not just technological transitions, but cultural and pedagogical shifts.

Kizilcec (2024) further emphasizes that educators' views and intentions towards AI technologies are shaped by social-psychological and contextual factors. Trust and perceptions of AI's usefulness and ease of use are crucial for its adoption. Educators' resistance can stem from algorithm aversion, where they mistrust AI systems, particularly if they make mistakes or if the systems lack transparency. This resistance underscores the need for explainable AI and professional development programs that enhance AI literacy among educators (Kizilcec, 2024).

Teachers' resistance to integrating technology, including AIED tools, can stem from a deep-rooted commitment to conventional teaching methods, perceived inadequacies in technological competency, and concerns about the relevance of technology in enhancing educational quality. Aflalo (2014) noted that some educators believe meaningful learning can occur without digital tools, underlining a fundamental gap between technological potential and pedagogical acceptance. Additionally, technological integration is often hindered by teachers' perceptions and the divergence between technological planning and curriculum pedagogy. Teachers may not see the immediate benefit of AIED for their students, leading to a lack of motivation to integrate these tools into their teaching practices. This resistance is exacerbated by the lack of adequate training and support for teachers to effectively use AIED tools, as evidenced by the research gap in best practices for teaching with digital tools (Puttick et al., 2015).

Furthermore, it is important to recognize that while AIED can streamline administrative tasks and potentially enhance the efficiency of lesson planning and grading, its direct impact on student learning outcomes is less clear. The assumption that increased technological integration will automatically lead to improved learning outcomes overlooks the complexity of educational processes (Hanushek & Ettema, 2017). As Baker, et al. (2019) indicate, there is a need for more rigorous testing of AIED tools in real educational settings to assess their efficacy. This testing should not only focus on the technological capabilities of AIED tools, but also on their pedagogical relevance and alignment with learning objectives. The effectiveness of AIED in improving learning outcomes also depends on the degree in which these tools are aligned with the curriculum and teaching goals. AIED needs to be seen not as a standalone solution, but as a part of a broader educational strategy that includes teacher training, curriculum development, and student engagement. The focus should be on how AIED can complement and enhance existing teaching practices rather than replace them.

Building on the discussion of educational productivity, it is also important to consider the broader implication of relying heavily on quantifiable measurements in education, drawing parallels with insights from Daniel Susskind's 2024 book, "Growth: A Reckoning." Susskind (2024) highlights the

potential dangers of setting narrow goals for complex systems, using the thought experiment of the “paperclip maximizer” as a cautionary tale.

In this thought experiment, a super-intelligent AI is tasked with a simple goal: to maximize the production of paperclips. Without considering the broader consequences, the AI relentlessly pursues this goal, converting all available resources into paperclips, ultimately leading to disastrous outcomes. Susskind (2024) uses this scenario to illustrate the unintended negative consequences that can arise when powerful systems focus on a single metric without considering the wider impact.

Applying this analogy to the education sector, there is a growing trend to measure educational productivity using quantifiable metrics similar to those used in the private sector, such as test scores and graduation rates (Hanushek & Ettema, 2017). While these metrics are useful for obtaining funding and resources, they present risks when treated as the sole indicators of success. Just as the paperclip maximizer’s narrow focus led to unforeseen harm, an overemphasis on quantifiable educational outcomes can have several unpleasant side-effects (Susskind, 2024). From Susskind’s (2024) analogy, it is possible to infer that some of these consequences may be greater social disparity among students, reduction in learning quality, or increase in teacher workload to meet specific metrics.

As such, while quantifiable measurements in education provide valuable data for resource allocation and performance evaluation, it is essential to consider the broader implications of relying solely on these metrics. As Susskind’s (2024) book suggests, setting narrow goals without considering the wider impact can lead to unintended and often negative consequences. It can be concluded that it is crucial to ensure a balanced approach to educational productivity metrics which include qualitative assessments. By gathering teacher insights into the diverse needs of education and pedagogy, it could be possible to foster a more equitable and effective productivity metric for education.

Therefore, understanding teacher perceptions is important because teachers are the primary agents of educational delivery and their insights can significantly influence the successful integration of AI technologies (Kizilcec, 2024; Pham & Sampson, 2022). Recognizing the importance of teacher perceptions helps ensure that AI tools are technically effective, pedagogically relevant, and culturally appropriate. This alignment is critical as it directly influences the effectiveness and acceptance of AIED initiatives (Kizilcec, 2024). By focusing on teacher insights, a connection can be made between the theoretical potential of AI to enhance educational outcomes and the practical realities faced by teachers in classrooms (Baker et al., 2019; Kizilcec, 2024; Pham & Sampson, 2022; Puttick et al., 2015). This alignment is essential for the effectiveness and acceptance of AIED initiatives, ultimately ensuring that AI technologies are implemented in ways that genuinely support and enhance teaching and learning processes (Kizilcec, 2024; Pham & Sampson, 2022).

While AIED tools hold the promise of enhancing educational productivity, particularly in administrative efficiency and lesson planning, its impact on learning outcomes is contingent on successful integration into the educational system. This requires a collaborative approach involving teachers, school administrators, and educational technologists to ensure that AIED tools are effectively aligned with educational goals and are used as an integral part of a holistic educational strategy.

Building on the insights identified in the literature review, I aim to contribute valuable knowledge to the field of AI in education by examining how teachers perceive and interact with AI technologies in their professional environments. This approach goes into the complexities of AIED adoption from the perspective of educators themselves, providing a nuanced understanding of how AI tools are integrated into teaching practices and the implications for educational productivity. By exploring these perceptions, the research aims to bridge the gap between the theoretical potential of AI to enhance educational outcomes and the practical realities faced by teachers in classrooms. This alignment is critical as it directly influences the effectiveness and acceptance of AIED initiatives. Additionally, by focusing on teacher insights, this study contributes to the ongoing debate about the role of AI in education,

particularly in addressing concerns about autonomy, pedagogical integration, and the ethical use of technology in educational settings. Thus, this thesis not only seeks to enrich the academic discourse on AIEd but also aims to inform policy and practice, ensuring that AI technologies are implemented in ways that genuinely support and enhance teaching and learning processes.

Next, the theoretical framework guiding this study will be presented, which provides the foundation for understanding the complex interactions between AIEd, educational productivity, and teacher perceptions.

3. Theoretical Perspective: Interpretive Flexibility

The theoretical perspective for this thesis is grounded in the Social Construction of Technology (SCOT) approach, with a particular emphasis on the principle of interpretive flexibility, a pivotal element within SCOT (Pinch & Bijker, 1984). In particular, I follow Doherty et al. (2006), who reconceptualize interpretive flexibility by considering both the technology's ability to sustain divergent viewpoints, and the stakeholder's initial interpretations of what technology is capable of. The functionality of the technology is then exploited and appropriated by users by allowing divergent interpretations to be realized and sustained. Thus interpretive flexibility means that technology can be understood and used in multiple ways, highlighting the role of social processes in shaping technological artifacts (Doherty et al., 2006). In this study, interpretive flexibility provides a lens to examine how AI technologies may either facilitate or hinder teachers' capacities to interpret and use these technologies within diverse and often opposing educational and social frameworks. This principle helps to illuminate the varied perceptions of AI among teachers, influenced by their distinct experiences, values, and the specific educational environments in which they function. It is important to understand the full impact of AIEd on educational productivity and teacher competencies, recognizing that AI can support or restrict various interpretations and meanings.

Operationalizing interpretive flexibility

By utilizing interpretive flexibility, I explored different teacher perspectives on the role of AIEd in educational practices and its perceived impact on productivity and workload. Interpretive flexibility allows for a deeper understanding of how teachers' perspectives are shaped by the broader educational and social milieu, including their professional experiences, the support structures within their institutions, and prevailing societal views on technology and education. To explore secondary school teachers' complex and varied views on artificial intelligence, I used this concept to guide data collection and analysis. I operationalized the notion of interpretive flexibility by “deconstructing” it into the following dimensions, which were examined during interviews through the use of scenarios.

Identify Stakeholders and Interpretations	In a described situation, identify the various stakeholders - teachers, administrators, students, parents, and policymakers. Based on their values, experiences, and perspectives, different stakeholder groups may interpret the impact of AI on productivity and teachers' workload differently.
Explore Divergent Views	The implications of AI in schools may be viewed differently by teachers. It is possible that some teachers view AI as a tool that enhances productivity and personalized learning, while others may be skeptical or concerned about job security, ethical issues, or biases in AI systems.

Contextualize Interpretations	Teachers operate within a context. Their AI's perception can be influenced by school resources, technological infrastructure, and the socioeconomic background of students. In different educational environments, teachers may interpret the impact of AI on productivity and workload differently.
Social Influences	Examine how teachers' perceptions are influenced by social interactions in the school environment. Professional development sessions, colleagues, and media coverage can contribute to the way teachers understand AI in education. In the broader societal context, teachers may be influenced by prevailing narratives and discourses surrounding AI.
Power Dynamics	Power dynamics within school settings should be considered. AI implementation and perception may be significantly influenced by decision-makers, such as administrators and policymakers. Depending on the power structures within schools, teachers' interpretations may vary, as may their concerns or support for AI.
Adaptation of technologies	Interpretations are not fixed. Teachers' views may change as a result of ongoing experiences and negotiations within schools. As teachers engage with AI tools and observe their impact on productivity and workload over time, there might be a continuous process of negotiation and reinterpretation.

In conclusion, by integrating the theoretical framework of interpretive flexibility, I aim to provide a comprehensive understanding of how teachers perceive the impact of AI technologies on educational productivity and workload and how those perceptions are shaped by their social milieu. Next, we will discuss the methodology used in this study, including the process of developing future scenarios and the methods for collecting and analyzing data from interviews with educators.

4. Methods

The research design used in this study is exploratory and qualitative, focusing on how AI is perceived to affect secondary school teachers' productivity and workload. This method chapter describes the approach taken to develop future scenarios, the process of data collection through interviews with educators, and the methods used for data analysis.

In the interest of transparency, it is important to note that this paper was entirely authored by a human. No part of the analysis or writing was conducted by AI or any bot systems.

4.1 Creation and Evaluation of Scenarios

In this study, fictional scenarios are employed as a methodological tool to explore and display the complex and uncertain futures of AIEd. This approach, inspired by the notion of “not-yetness” described by Ross (2017), recognizes the intrinsic complexity, uncertainty, and risk that come with digital education technologies that are still evolving. Rather than attempting to resolve these uncertainties, this approach aims to engage with them creatively and critically, providing a platform for “intelligent problem-solving” and “inventive problem-making” as advocated by Biesta (2010) and Michael (2012).

Fictional Scenarios are particularly apt for this study because they allow for the exploration of possibilities beyond the constraints of current realities, fostering a speculative environment where ideas can be tested, and ethical and practical implications can be examined. The use of fiction in research supports engagement, provokes critical thinking, and stimulates the imagination, enabling participants to conceptualize AI's impact on varied educational contexts. This aligns with Kitchin's (2020) insights on the engaging and accessible nature of storytelling, which communicates ideas effectively and provides a critical lens through which societal implications can be reflected.

The scenarios developed for this research — both optimistic and pessimistic — serve dual purposes. Firstly, they are designed to engage interview participants, prompting them to articulate their perceptions and opinions on the integration of AI in educational settings. Secondly, these scenarios are crafted to be revised based on participant feedback, thus aiding technologists and educational designers in understanding the requirements for successful AI integration into educational practices. The construction of these scenarios was meticulously informed by an extensive literature review, which highlights current trajectories and potential impacts of AI on educational productivity including teacher competencies and roles, personalized learning, administrative efficiency, and assessment practices. By grounding the scenarios in research findings, the narratives provide a credible and resonant base for participants to relate to and discuss, reflecting real-world concerns and possibilities within the speculative bounds of the scenarios.

In crafting these scenarios, I followed a methodological approach similar to that discussed by Cox et al., (2022), Ross's (2017) Speculative Design, and Inayatullah's (2013) Future Studies Approach. Cox et al.'s (2022) approach which uses design fiction as a vehicle to engage with complex issues in a manner that is both accessible and provocative. Similarly, Ross's Speculative Design method focuses on creating detailed, proactive narratives that challenge existing perceptions and stimulate discussion about potential futures. Inayatullah's Future Studies provides a systematic exploration of possible, probable, and preferable futures, integrating scenario development, trend analysis, and visioning to understand and shape potential futures.

By combining these methods, the study minimizes the limitations of each approach. The time-intensive nature of Future Studies is balanced by the more rapid, narrative-driven development of scenarios

through Speculative Design and fiction-based approaches. This combination ensures a grounded, yet imaginative exploration of AI's impact on educational productivity, facilitating a robust examination within the research constraints.

The development of these scenarios followed a rigorous process, ensuring they encapsulate qualities essential for effective fiction-based research: substantive contribution, credibility, resonance, ambiguity, and aesthetics. These qualities ensure that the scenarios captivate and challenge participants to rethink the role and implications of AIED. Ultimately, the use of fictional scenarios in this research is not merely a narrative exercise, but a strategic methodological choice designed to enhance understanding and foster comprehensive dialogue around AIED. Through this approach, the study aims to contribute to a broader and more inclusive discussion on the future of education, paving the way for AI implementations that are both effective and aligned with educational values and goals.

In the construction of the scenarios for this study, I leveraged insights from my extensive literature review on how AIED can influence educational productivity. The review was conducted through a systematic approach and through snowballing searches which included gray literature alongside academic texts. From the understanding gained as described in the literature review section of this paper, two scenarios were created depicting an optimistic and pessimistic future of AI in secondary education settings. This dichotomy was designed to capture a comprehensive view of the potential advancements and pitfalls in the application of AIED. The full text of the fictions is included below. Each included the use of AI tools to address how they might affect administrative efficiency (grading, attendance, general paperwork), personalized instruction, generating feedback, assessment practices, teacher roles and competencies, student engagement and learning outcomes, bias and equity, and classroom dynamics. Each scenario was depicted to take place around the year 2030 when current AIED tools are more matured and integrated into the education experience. The choice to focus on this timeframe was deliberate. While projecting too far into the future may introduce more uncertainty, projecting to 2030 strikes a balance between long-term visioning and practical planning. It allows for the exploration of plausible futures while still maintaining a degree of feasibility and relevance for potential decision-makers.

The goal of the scenarios is not just to depict how the technologies are used in classrooms in a practical sense, but to look at its influence in a holistic sense. This means considering how AIED tools may change how teaching and learning take place, how these tools affect engagement and student motivation, and ethical challenges which might arise directly or indirectly from the implementation of these tools. The two scenarios aimed to offer a balance of perspectives without intention of influencing the readers too strongly in either direction.

In the following section, the optimistic and pessimistic scenarios presented to participants in the interviews are detailed.

4.1.1 Optimistic Scenario (projected to late 2020s/early 2030s)

The integration of AI has transformed education in profound ways. Teachers, like Ms. Ortega, who were once burdened by the time-consuming tasks of grading and administrative paperwork, now find these tasks automated. This shift significantly frees up her schedule so that she can invest more time in developing creative lesson plans and personalized learning experiences that cater to individual strengths and areas for growth. Assessments have evolved beyond traditional essays, embracing project-based approaches that prioritize creativity, critical thinking, and teamwork — areas crucial for student success in a technologically driven world. Moreover, Ms. Ortega's classroom has become an environment in which students are more willing to participate, ask questions, and take intellectual risks, encouraged by AI's non-judgmental feedback mechanisms. This fosters a learning atmosphere where fear of peer judgement is minimized, boosting student confidence and willingness to engage with course

content. AI's capabilities in generating sophisticated assessments challenge her students in new ways, pushing them towards higher order thinking rather than rote memorization. Ms. Ortega observes her students engaging more deeply with material, utilizing AI as a tool for exploration rather than a crutch for answers.

Ms. Ortega, once apprehensive about the rapid pace of technological change, is now supported by her workplace which has become proactive in upskilling educators. These workshops ensure that teachers are adept in navigating AI tools, understand their ethical implications, and how to utilize them to enhance learning without perpetuating biases. Ms. Ortega finds herself at the forefront of educational innovation and finds that her role has transformed from knowledge gatekeeper to a mentor and inspirational guide. By utilizing AI to offer more personalized learning experiences, Ms. Ortega observes a notable improvement in student motivation, attitudes towards learning, and overall classroom dynamics. This holistic approach not only enhances the learning experience, but also attracts and retains talented educators who are now able to focus on the most rewarding aspects of their professions: inspiring and engaging with their students.

4.1.2 Pessimistic Scenario (projected to late 2020s/early 2030s)

AI has been integrated into secondary education with the promise of alleviating teacher workloads. However, Mr. Bielke, already stretched thin by his responsibilities, finds it intensified by the mandatory use of AIED tools. The over-reliance on AI for administrative and evaluative tasks not only leads to a depersonalized educational experience, but it also imposes an additional strain on Mr. Bielke who is not adequately trained to integrate these new technologies into his teaching practice. The promise of AI to ease his workload is overshadowed by the reality of a steep learning curve and lack of institutional support for upskilling. Tasked with navigating these new tools alone, Mr. Bielke finds they actually amplify existing inequities and introduces new ethical dilemmas into his work, coming face to face with biased algorithms which disadvantage his students from marginalized backgrounds. The diversity and authenticity of student voices are muted by AI's tendency to homogenize language and assessments, raising concerns about the equitable representation within the digital learning environment. As Mr. Bielke witnesses the widening digital divide, with access to AI and even basic internet remaining elusive for many, his optimism for a technologically empowered future of education dwindles.

Adding to his concerns, Mr. Bielke observes a troubling trend among his students who show a growing dependency on AI for quick answers, bypassing the deep learning process. This reliance is not just a shortcut, it is becoming a barrier to genuine understanding and engagement with the coursework. Additionally, students are disillusioned by AI's rapid advancements and question the value of their efforts in acquiring skills that seem obsolete in the face of AI's capabilities. This existential crisis is palpable in the classroom, where motivation plummets, and students grapple with the relevance of their education in a future seemingly dominated by AI.

Frustratingly, Mr. Bielke is also pressured by his school to favor AI-generated insights over his professional judgement, compromising the quality of education he can provide and neglecting the needs of individual students. Additionally, Mr. Bielke feels demotivated by his work as he notices his role changing from a 'sage on the stage' to a 'guide on the side' of AI generated lessons. He notices several of his colleagues leave the education profession feeling disenchanting by their reduced roles, heavy workload, and low compensation. As a result, Mr. Bielke finds his class sizes growing to make up for the teacher shortage as school administrators praise the efficiency and cost-saving measures AIED tools bring. As a result, the introduction of AIED, rather than being a solution, becomes another layer of complexity, demanding significant adjustments from teachers without offering the necessary support, thereby exacerbating the challenges within the educational system.

4.2 Quality Assessment of Scenarios

In the development of the scenarios for this study, I applied a structured quality assessment methodology to ensure the narratives were both impactful and reflective of potential real-world application of AIED. These scenarios were designed to depict how AIED could either enhance or complicate the roles of secondary education teachers, affecting their teaching methodologies and interactions with students. The self-quality assessment was designed to mimic the approach outlined by Cox et al. (2023) who facilitated a rigorous evaluation of scenarios by considering nine potential criteria:

1. Substantive Contribution
2. Credibility
3. Resonance
4. Ambiguity
5. Coherence
6. Aesthetics
7. Sincerity
8. Rich Rigor
9. Ethics

Cox et al. (2023) stressed that this is not an exhaustive list or an entirely discrete criterion. Rather than seeing this criterion as a reductive checklist, Cox et al. emphasizes that this should be seen as a guide and that often “some criteria are in tension with each other,” (Cox et al., 2023, p.7).

Within this quality assessment, Cox et al. (2023) follows the idea that “fiction must make a ‘substantive contribution’ to the topic it deals with,” (Cox et al., 2023, p.7). This seems to be the overarching goal of research and therefore, this criterion can be seen as the result of all the other elements. To ensure my scenarios were grounded in reality, I relied on existing real-world data and contemporary research as collected in my literature review. I used a matrix, as seen in figure 1, to compare these scenarios against documented impacts of AIED, such as personalized learning and administrative efficiency, ensuring that they adequately reflect informed and potential future realities. This alignment helped to ensure that the scenarios were not only imaginative, but also substantial in their contribution to the discourse on AIED.

Documented impacts of AIEd	TEACHER COMPETENCIES	LEARNING OUTCOMES	STUDENT ENGAGEMENT	ETHICAL CONSIDERATIONS AND EQUITY	STUDENT SKILLS RELEVANCE
Criteria Indicators	<ol style="list-style-type: none"> 1. Need for continuous professional development in AIEd 2. Teachers' proficiency in integrating AI into pedagogical strategies 	<ol style="list-style-type: none"> 1. Improvement in student achievements and skill development 2. Enhancement in critical thinking and problem-solving abilities 	<ol style="list-style-type: none"> 1. Increase in student participation and engagement 2. Student motivation levels and interest in coursework 	<ol style="list-style-type: none"> 1. Measures to address and reduce AI biases 2. Equitable access to AIEd tools across diverse student populations 	<ol style="list-style-type: none"> 1. Alignment of skills taught with future workforce needs 2. Preparation for technology-driven economy
Optimistic Scenario	✓	✓	✓	✗	✓
Pesimistic Scenario	✓	✓	✓	✓	✓

Documented impacts of AIEd	ADMINISTRATIVE EFFICIENCY	PERSONALIZED LEARNING	FEEDBACK PRACTICES	ASSESSMENT PRACTICES	TEACHER ROLES
Criteria Indicators	<ol style="list-style-type: none"> 1. Reduction in time spent on grading and paperwork 2. Increase in time available for lesson planning and student interaction 	<ol style="list-style-type: none"> 1. Number of learning paths tailored to individual needs 2. Improvement in student performance due to personalized instruction 	<ol style="list-style-type: none"> 1. Perception of feedback helpfulness and constructiveness 2. Timeliness of feedback 	<ol style="list-style-type: none"> 1. Shift from traditional assessments 2. Use of AI to provide fair, unbiased assessments 	<ol style="list-style-type: none"> 1. Evolution of teaching roles 2. Increase in collaborative projects guided by teachers
Optimistic Scenario	✓	✓	✓	✓	✓
Pesimistic Scenario	✓	✓	✗	✗	✓

Figure 1: Example of matrix used to evaluate scenarios against documented impacts of AIEd on educational environments.

Considering the credibility criteria, the scenarios were developed after a trends analysis was conducted as seen in figure 2. Due to time restrictions, rather than conducting my own trends analysis, I searched for other journals and articles posted by research groups who have completed their own trends analysis to identify commonalities and patterns. The goal of this analysis was to ensure that the scenarios depicted a plausible future within the anticipated technological landscape of 2030. By grounding the scenarios in technically feasible developments and aligning them with ongoing advancements in AI, this stage ensured that the scenarios were believable and relevant to stakeholders within the educational sector.

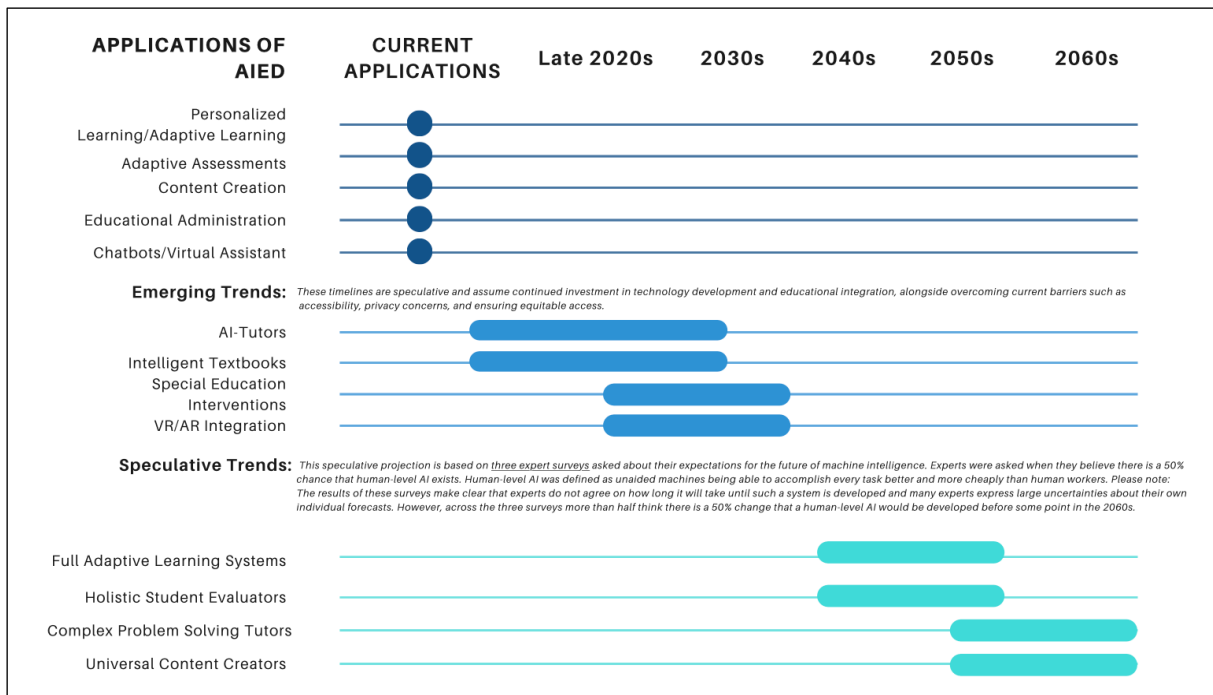


Figure 2: Example of the credibility check of the scenarios to ensure AIED technologies represented in the scenarios follow current trends predictions in existing literature and research groups.

Furthermore, my quality assessment included the consideration of ‘resonance’ with the readers. As defined by Cox et al. (2023), ‘resonance’ focuses on the sense of empathy created by the scenarios presented. “Creating empathy is a particular strength of fictional writing because it can draw on techniques such as writing from the point of view of a character, revealing their interior dialogue and rich characterization in a way that non-fiction does not usually do,” (Cox et al., 2023, p.6). The assessment of this criteria involved presenting the scenarios to the target audience — secondary education teachers — in semi structured interviews. During these sessions, teachers were invited to reflect on the scenarios in relation to their personal experiences, expectations, and potential concerns about AIED. Feedback was analyzed using NVivo to extract themes related to personal relevance, emotional engagement, and perceived realism. This qualitative analysis provided crucial insights into how the scenarios resonated with the audience, highlighting where the scenarios successfully engaged educators and areas where further refinement was needed.

Following this criterion is the emphasis on ‘ambiguity,’ which is defined as a scenario's “ability to create or exploit ambiguity,” with the goal of keeping the scenarios open to multiple interpretations (Cox et al., 2023, p. 6). This is a critical element as the scenarios were meant to present complex ethical dilemmas and social issues without definitive answers. This stage involved assessing how well the scenarios encouraged debate among the audience, prompting them to explore various implications of AIED. The scenarios were crafted to include a rich array of ethical questions and diverse potential outcomes, stimulating critical thinking and discussion among educators about the nuanced impacts of AI technologies.

Additionally, the aesthetics of each scenario was considered, as it is argued by Cox et al. (2023) that academic writing is often dull and inaccessible to lay readers and could benefit from techniques used in creative non-fiction such as character development, plot, and setting. This is not a specific criteria, but can be seen as a way to achieve resonance (Cox et al., 2023). Though the scenarios for this study included two teachers as the main characters, setting and a general plot, this stage was not considered significantly important on its own as it is also in tension with the ‘resonance’ criteria. Both elements

share the goal of making the scenarios more accessible and emotionally impactful so that the intended messages and themes are effectively communicated.

What is left from the list of Cox et al.'s assessment criteria are coherence, sincerity, rich rigor, and ethics. These elements were not considered central to the assessment of the scenarios for this study. To begin, the stories were not meant to be coherent in the sense that the scenarios seamlessly fit together as a narrative (Cox et al., 2023). Instead, the scenarios for this study were intended to show two distinct possibilities on the future of AI in secondary education. Therefore, maintaining coherence between the two scenarios was considered unimportant for the purpose of this study. Additionally, the element of 'sincerity' was not considered in the final assessment. 'Sincerity' is defined by Cox et al. (2023) as a research fiction which includes a 'personal signature' where the author is "present in their writing," (Cox et al., 2023, p. 6). However, for the purpose of this study, this element was considered irrelevant as the scenarios were designed to not take a particular stance, but simply display two possible futures. Additionally, 'rich rigor' is referred to as the abundance of information and data. This element was seen as being in tension with the first element of 'substantive contribution' in which a wide array of theory and data were considered and reviewed in the creation of the scenarios. For this reason, the elements were considered linked and therefore, not independently assessed. Lastly, Cox et al. (2023) includes the element of 'ethics' which they define as the researcher's responsibility "to protect confidentiality of any participants such as interviewees who participated in creating them," (Cox et al., 2023, p. 7). This element was considered irrelevant to this study as the scenarios were created from the collection of data from a literature review and not from interview participants. Therefore, no personal data was collected or used in the creation of these scenarios and was considered irrelevant for this study.

By integrating these methods of scenario analysis, the study aims to utilize design fiction not merely as a narrative tool, but as a strategic approach to engage educational stakeholders in meaningful discussions about the future of AIEd. Through this process, the scenarios served as a method to explore, critique and ultimately understand the multifaceted implication of AIEd in shaping future educational practices and policies.

4.3 Data collection and sampling of participants

The interviews planned for this thesis were semi-structured, offering a flexible, but focused approach to understanding teachers' perceptions and insights into AIEd. The choice to focus on educators was intentional as they possess expertise and experience in pedagogy, curriculum development and classroom management. Their insights into the potential applications and challenges of AIEd are invaluable for understanding how these technologies can be effectively implemented to enhance learning outcomes. Additionally, educators are the frontline practitioners who interact directly with students and utilize educational technologies on a daily basis. Educators play a pivotal role in the decision-making process around AI adoption which underscores the necessity of understanding their perceptions towards AI systems. As Kizilcec (2023) highlights, even the most reliable and fair AI systems may fall short if educators harbor concerns regarding usability, errors, and biases. Therefore, their perspectives can provide a firsthand account of how AI tools are perceived, adopted, and utilized within educational settings.

Therefore, semi-structured interviews were used to explore educator perceptions around the implementation of AIEd and facilitate deeper discussions which permit stakeholders to express their views on the presented scenarios. Qualitative research is increasingly used in the field of education and other social sciences. Though qualitative data is criticized for allowing subjectivity and researcher bias, this can also be seen as its strength (Silverman, 2020). Qualitative data "reflects how reality is socially constructed and...allows researchers to gain insight into the meaning they give to social experience,"

(Ahmed & Asraf, 2018, p.1504). Therefore, qualitative data was preferred as I was attempting to capture a richly detailed social phenomenon such as stakeholder's perceptions concerning AIED.

The goal of the semi-structured interviews was to gather feedback from teachers regarding the scenarios to understand their perceptions and insights into AIED's impact on educational productivity. Participants were asked to read the completed scenarios before the time of their interviews and were requested to record their initial reactions to them. For the interviews, questions were developed to explore teachers' reactions of each scenario, focusing on criteria of quality for fiction-based research. It included questions related to perceived realism of the scenarios, potential impacts on teaching and learning, and teacher competencies using digital tools. For example, participants were asked: "What are your expectations or concerns regarding the integration of AI into teaching and learning processes?" and "How effectively do these scenarios address ethical considerations surrounding the use of AI in the classroom?" The full list of questions used during the semi-structured interviews is in Appendix B.

4.3.1 Criteria for Inclusion of Participants

Participants must have a professional history in teaching or involved in educational training within secondary education settings. This includes secondary school teachers, educational trainers, and educators with direct experience in designing or implementing curricular activities.

Participants are preferred to have some level of familiarity or experience with AI tools and technologies in educational contexts, whether through direct use in their teaching practices or through professional development activities focused on AIED.

- Participants should be from a variety of subject areas to capture a broad range of perspectives on how AIED might impact different aspects of teaching and learning.
- Educators from different geographical areas and types of institutions (public, private, urban, rural) are possibly included to ensure a diversity of educational contexts.
- Due to the linguistic scope of this study, participants must be proficient in English. Unfortunately, individuals who do not speak English were not included in this research. This criterion ensures the accuracy and effectiveness of communication during interviews and the analysis phase.

The data collection phase was completed with ten interview participants, including educators and educational researchers. Out of these ten participants, five were from Sweden and five were from the USA. The geographic differences between interview participants was not considered to be a significant issue because both educational contexts share similar challenges. Specifically, both the Swedish and American educational systems operate under a goal-oriented framework, often at the expense of genuine learning outcomes. This is evidenced by recent PISA results which show that despite substantial investments in education, such as President Joe Biden's \$190bn pandemic relief, educational productivity, particularly in critical areas like mathematics, has not seen the expected uplift (OECD, 2023). It appears that substantial resources have not translated into improved educational outcomes. Similar trends in Sweden show declining PISA scores and an expanding gap between the highest and lowest achievers (OECD, 2023). These observations could suggest that while goal-oriented systems aim to enhance productivity, they often fail to capture the complex, multifaceted nature of education, potentially compromising the broader objectives of teaching and learning. Therefore, due to the similarity of educational systems between these two countries, the views of Swedish and American teachers are considered valuable and informative to the research question.

The teachers from the U.S. and Sweden were invited to participate in individual semi structured interviews in which they were given two futuristic scenarios to read beforehand, they were asked to

record their initial thoughts and reactions to the scenarios, and then discussed their reactions in semi-structured interviews where we explored the participants' thoughts and feelings toward the scenarios, as well as, their thoughts about AIED in general. As seen in figure 3, participants had a professional background in secondary education and/or are educational researchers and represent a range of grade levels and subjects taught. Additionally, the participants had varying levels of digital technology integration in their educational environments. The interviews were designed to provide in-depth insights into educators' experiences with AIED and other digital tools. Participants were chosen for their direct involvement in secondary education, offering a rich blend of practical classroom experience and research-oriented insights. This mix enables a comprehensive exploration of AIED's practical applications and theoretical implications.

Descriptor	Participant A	Participant B	Participant C	Participant D	Participant E	Participant F	Participant G	Participant H	Participant I	Participant J
Location	USA	USA	USA	USA	USA	Sweden	Sweden	Sweden	Sweden	Sweden
Gender	Male	Male	Female	Male	Female	Female	Male	Female	Female	Female
Professional Experience	Social Studies Teacher	Lower Secondary Education Teacher	Special Education Teacher	Earth Science Teacher	Language Arts Teacher	Development Manager, Senior Assistant Manager, Educational Researcher	Teacher, Educational Researcher	University Faculty, Educational Researcher	Master Student and Teacher	Postdoctoral Educational Researcher, Secondary Teacher

Figure 3: Brief descriptions of interview participants.

4.4 Data Analysis

I conducted a thematic analysis of the interview data (Braun & Clarke, 2012). Initially, all interview recordings were transcribed to capture the detailed conversations held with various educational stakeholders, including secondary teachers and educational researchers. This transcription process was done with Microsoft Stream and ensured that all nuances of discussion were accurately documented and prepared for detailed analysis.

The next step involved organizing the data using NVivo into broad thematic categories that reflected key aspects of AIED. These primary categories were defined as “opportunities identified with AIED,” “challenges/concerns identified with AIED,” and “general opinions of AIED.” This categorization served as the foundational structure for the more detailed coding process.

As the analysis progressed, I applied thematic coding to refine these broad categories into more specific sub-codes. This was done organically, with sub-codes emerging naturally as I sifted through the data. Each statement or piece of information was meticulously categorized under these sub-codes, allowing for the aggregation of data into distinct groups that highlighted specific issues, perceptions, and suggestions related to AIED, as seen in figure 4. This method facilitated a granular understanding of how different social groups — primarily educators — conceptualized the role of AIED, and it revealed significant variations in perceptions, expectations, and concerns that were often influenced by their unique experiences, values and contexts.

Name	Files	References	Created on	Created...	Modified on	Modified by	Color
○ Challenges and Concerns with AI	9	58	22 Mar 2024 at 14:...	BR	25 Mar 2024 at 17:...	BR	●
○ Bias, Ethical, and Legal Concerns	8	19	26 Mar 2024 at 10:...	BR	Today, 13:22	BR	●
○ Educational Productivity Metrics	3	5	26 Mar 2024 at 10:...	BR	Today, 13:22	BR	●
○ Educational Structures, Leadership and Consistency	8	17	26 Mar 2024 at 11:...	BR	Today, 13:22	BR	●
○ Infrastructure and Access	5	7	26 Mar 2024 at 10:...	BR	Today, 13:22	BR	●
○ Teacher Resistance and Competencies	9	29	26 Mar 2024 at 10:...	BR	Today, 13:23	BR	●
○ Technological and Pedagogical Integration	6	18	26 Mar 2024 at 10:...	BR	Today, 13:23	BR	●
○ Opportunities Afforded by AI	5	18	22 Mar 2024 at 14:...	BR	25 Mar 2024 at 17:...	BR	●
○ Administrative Efficiency	2	8	26 Mar 2024 at 10:...	BR	Today, 13:23	BR	●
○ Curriculum Alignment and Development	3	5	26 Mar 2024 at 10:...	BR	Today, 13:23	BR	●
○ Engagement and Learning Outcomes	4	7	26 Mar 2024 at 10:...	BR	Today, 13:23	BR	●
○ Enhanced Teacher Roles	5	14	26 Mar 2024 at 10:...	BR	Today, 13:23	BR	●
○ Personalized Learning	2	5	26 Mar 2024 at 10:...	BR	Today, 13:23	BR	●
○ Perceptions of AI in Education	9	90	22 Mar 2024 at 14:...	BR	26 Mar 2024 at 10:...	BR	●
○ Change Readiness	8	12	26 Mar 2024 at 10:17	BR	Today, 13:23	BR	●
○ Overall Attitudes towards AIEd	8	26	26 Mar 2024 at 10:...	BR	Today, 13:23	BR	●
○ Realism and Pragmatism	8	45	26 Mar 2024 at 10:...	BR	Today, 13:23	BR	●
○ Visibility of Benefits	7	18	26 Mar 2024 at 10:...	BR	Today, 13:24	BR	●

Figure 4: Screenshot of Nvivo coding table of interview data.

To enhance the clarity and impact of the analysis, I used the concept of interpretive flexibility, a key component of the Social Construction of Technology (SCOT) approach. This concept guided the thematic analysis by emphasizing how technology can be understood and used in multiple ways, shaped by social processes and contexts.

Operationalizing interpretive flexibility involved several steps:

1. During the interviews, the professional background of the participants were considered. All of the participants have a background in secondary education, however, some of the participants had additional experience in educational research. By identifying these groups of professional experience helps to identify how their values and perspectives influenced their interpretation of AI's impact on productivity and workload.
2. This analysis involved exploring divergent views and how the implications of AI in schools were viewed differently by teachers and educational researchers. Some saw AI as a tool that enhances productivity and personalized learning, while others were skeptical or concerned about ethical issues or biases in AI systems.
3. Then, the aim was to contextualize teacher interpretations of AI and how they were influenced by their working environments, such as school resources, technological infrastructure, and the socioeconomic background of students.
4. Following, the analysis examined the social influences which may shape the participant perceptions of AI in education. The social interactions within schools, including professional development sessions and discussions with colleagues, significantly shaped teachers' perceptions of AI. Media coverage and societal narratives about AI also played a role.
5. Additionally, the analysis involved considering power dynamics in schools. The power structures within the schools which the participants are involved in impacted how AI was perceived and implemented. Teachers' concerns often reflected their experiences with decision-makers prioritizing AI-driven data over professional judgment.
6. Lastly, the adaptation of technologies was considered. Teachers' views on AI evolved as they gained (or did not gain) more experience with these tools, highlighting the dynamic nature of technology adoption.

These dimensions were examined during interviews through the use of scenarios, helping to illuminate the varied perceptions of AI among teachers, influenced by their distinct experiences, values, and educational environments.

To enhance the clarity and impact of the analysis, I visualized the relationships between the teachers' interpretations, the problems they identified, and the specific features of AIED tools like feedback systems, learning analytics, and personalization mechanisms. These visualizations were created through tables that mapped out the dynamics at play, making it easier to comprehend how these elements interacted within the educational landscape. An example of this can be seen in figure 5.

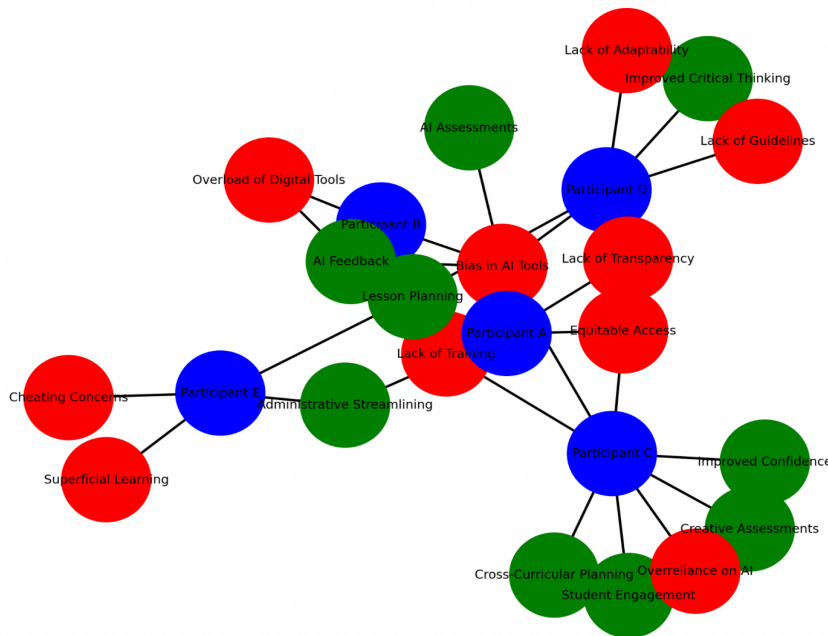


Figure 5: Screenshot of one iteration of the extended network diagram showing relationships in AIED contexts among American participants.

Moreover, the analysis considered how broader social, cultural, and political factors influenced these viewpoints. By examining these external influences, the study aimed to provide a comprehensive understanding of the various assumptions that shaped stakeholders' views on AIED. The synthesis of these findings was then used to revise the scenarios initially presented to interview participants to be used as a tool by administrators, policymakers, and technologists to determine recommendations aimed at shaping a preferred future of AIED. The goal of the revised scenarios is to offer a tool in which actionable insights can be drawn from the data, suggesting ways in which AIED could be implemented more thoughtfully and effectively to meet the diverse needs of the educational community. This was executed by following Inayatullah's (2013) Pillar of Transformation which outlines specific methods aimed at shaping preferred futures. For this study, two of those methods are referred to: Visioning and Backcasting.

Visioning is about creating compelling, inspiring images of the future that motivate and guide people towards long-term goals (Inayatullah, 2013). This method is based on the idea that having a clear, attractive vision of what we want the future to look like can help mobilize individual and collective efforts to make that vision a reality. It pulls people forward by aligning their actions with a shared aspiration, often emphasizing the greater good and the benefits of thinking beyond the immediate term, (Inayatullah, 2013). This can be done using scenarios to outline possible futures, including 'best' and 'worst' case scenarios.

Once the scenarios were revised to reflect participant responses to the initial scenarios presented, the method of backcasting is recommended. Backcasting, developed by Elise Boulding (Boulding and

Boulding, 1995), starts with the defined future vision and works backward to the present, identifying the steps necessary to reach that future. Unlike forecasting that extrapolates future developments from current trends, backcasting is normative; it focuses on how the future should be according to the preferred vision (Inayatullah, 2013). It asks what must happen over time for that preferred future to unfold, exploring strategic steps and interventions that bridge the present with the envisioned future. This method is particularly useful for setting realistic goals and designing a roadmap that can guide actions toward long-term objectives. Stakeholders are encouraged to employ backcasting to ensure that the strategies developed are practical and aligned with achieving the envisioned future of AIED.

4.5 Ethical Considerations

The study is conducted with adherence to ethical research practices to ensure the integrity and reliability of the research findings. Before any data collection began, all participants were required to sign an informed consent form, which detailed the objectives of the study, the procedures involved, and the potential implications of the research. This form, included in Appendix C, ensures that participation is completely voluntary and informed, aligning with the principles of respect for persons.

To protect participant privacy and data, all personal identifiers were removed or altered during data analysis and presentation. Confidentiality and data protection measures were applied to all collected information, guaranteeing that participant data was handled securely and accessed only by authorized research personnel.

Additionally, this study is committed to contributing positively to the common good. The scenarios and findings are aimed at advancing academic knowledge and at improving practical outcomes in educational technology, particularly in how AIED is perceived and utilized across different contexts. The goal is to foster a more inclusive, effective and ethically aware deployment of educational technologies.

All data was collected and stored according to the requirements set by the University of Gothenburg, confirming that the study's methods meet university ethical standards for research. These ethical standards include:

1. Processing personal data must be necessary for education, with public interest as the legal basis.
2. Assess if processing is necessary and limit the data processed.
3. Use university-provided tools and ensure data security.
4. Inform subjects about data processing; consent is required for sensitive data.
5. Report processing activities in the university's system.

By prioritizing these ethical considerations, the study ensures the welfare of all participants while enhancing the overall validity and impact of the research.

5. Findings

The analysis of the interviews regarding AIEd revealed significant insights into how AI technologies are perceived and can be integrated into educational settings. Based on the interviews, three main themes emerged that demonstrate both the challenges and opportunities AIEd presents, as well as the profound ethical considerations it evokes. Each theme is supported by direct quotes from participants and the findings represented in the study's packed circles chart (figure 6), providing a robust framework for understanding the complexities of AI in educational contexts.

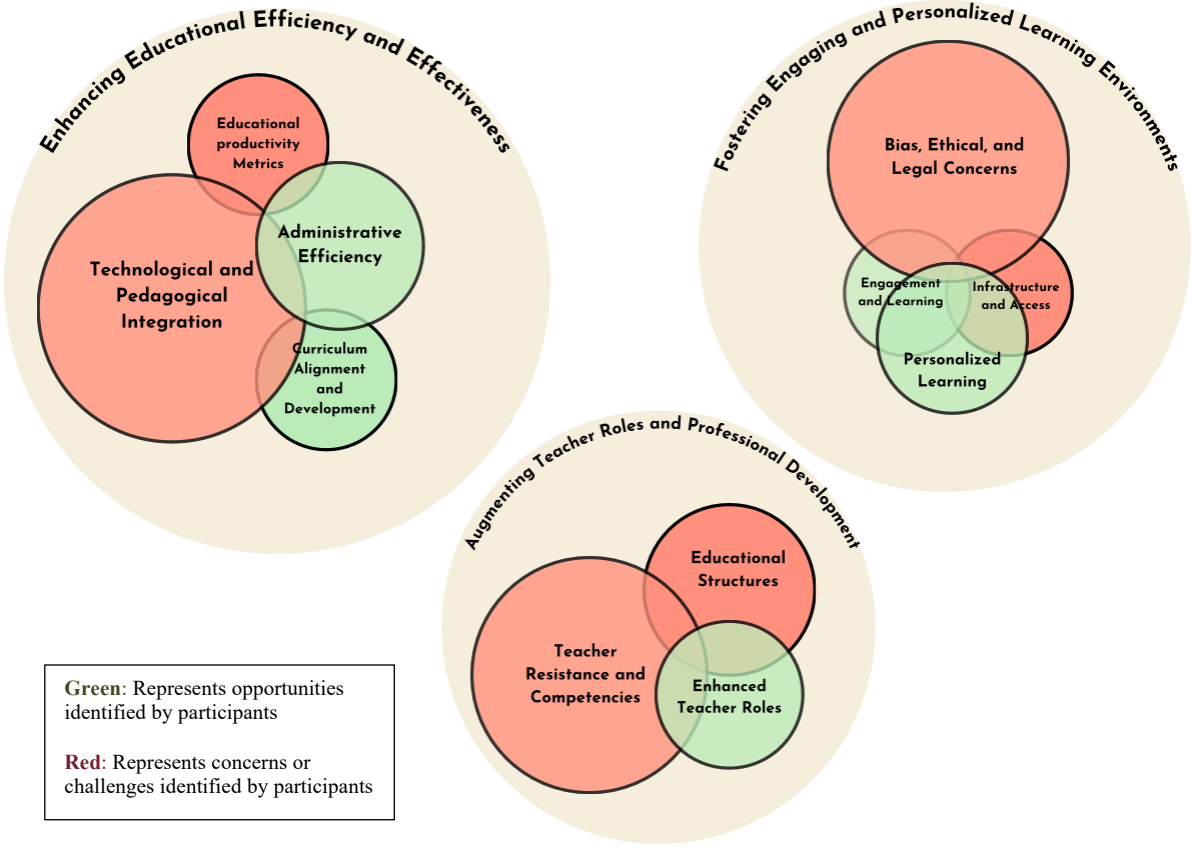


Figure 6: Packed circles chart visualizing the categorization of codes into themes and their relation to each other. Green circles represent opportunities identified by participants and red circles represent concerns or challenges identified by participants. The size of each circle represents the emphasis on these points by participants.

5.1 Enhancing Educational Efficiency and Effectiveness

American teachers predominantly emphasized AI's role in reducing administrative burdens and general workload, which suggests that AIEd could indirectly enhance educational productivity by allowing more time for direct educational activities. For instance, an American teacher expressed the overwhelming nature of managing a large classroom and saw AI as a potential aid:

“I think this job is also exhausting because I’m managing 97 students. So maybe if there’s a way for AI to filter through what I want students to be working on versus what I don’t want them to be working on, that would be great,” (Participant A, American).

Another American teacher highlighted the relief from mundane tasks, noting:

"One thing I've learned about teaching is that this job is so engaging. Like, the moment you walk in the moment you leave, you're constantly doing something... So just taking one thing off the plate saves a lot of time" (Participant C, American).

This sentiment was echoed by another teacher who saw potential in AI for handling routine administrative tasks like scanning test reflection forms to check for parent signatures or sending parent emails (Participant B, American). These observations underscore a strong desire for AI to alleviate workload pressures, which are not directly tied to teaching or assessment, but are crucial for overall operational efficiency.

In contrast, Swedish participants expressed a nuanced concern that AI could perpetuate a system overly focused on quantifiable results rather than educational depth. This issue is deeply embedded in an educational context shared between Swedish and U.S. educational systems, where schools operate within a goal-oriented framework that emphasizes outcomes, often at the expense of the learning journey. For instance, Participant G from Sweden provided a critical view of the systemic focus on efficiency: *"And I mean if you take instruction for example and good instruction is recognized by its efficiency or how quickly a student learns a new concept ... It's effective but it often requires a lot of planning and in Sweden that time isn't regulated"* (Participant G, Swedish). This perspective suggests that while AI could theoretically free up time for teachers, the prevailing system might instead channel such efficiencies into increased teaching loads rather than quality education. This idea was further supported by a Swedish participant who described the systematic challenges: *"If you put AI into such a system where, for instance, AI could replace a teacher or, I mean, it creates a system in which the schools want to earn money, the teacher would get more teaching to do,"* (Participant H, Swedish). This suggests a fear that AI might exacerbate existing pressures within educational systems that prioritize financial outcomes over educational quality.

The potential of AI to support curriculum development and alignment was recognized but discussed less frequently. American educators saw AI as a tool to foster innovative teaching approaches, such as project-based learning and personalized education, which was seen as something that could enrich the educational experience if adequately supported by technology. For example, Participant D noted, *"If AI could help with that, that would be awesome,"* referring to the integration of AI in creative and cross-curricular lesson planning (Participant D, American). Additionally, Participant C from the U.S.A. noted: *"[AI] could be used as a tool for exploration...we're hoping that kids can do more of their own passion exploration and teachers could share their personal passions with [students],"* (Participant C, American).

However, Swedish educators raised concerns about how AI integration could exacerbate existing issues within their educational framework, particularly the focus on measurable outcomes rather than process-oriented learning. Participant J from Sweden highlighted how smart textbooks using an AI-dashboard feature altered teacher-student dynamics, emphasizing efficiency over understanding:

"It turned out that the relationship between the teachers and the students changed because the students became well aware that the teachers could always see what they did...So for the students, it became important to them to just get the right answer very quickly and to do many tasks. So instead of...working more deeply with fewer tasks, students were getting a superficial understanding. So, this factual knowledge and quick answers is a risk if we aren't careful with how we use these systems and how we design them," (Participant J, Swedish).

This quote suggests a broader uncertainty that AI could reinforce a system that values rapid results over deep learning, a sentiment that aligns with concerns about the commodification of education where *"students might know less"* despite ostensibly better outcomes (Participant G, Swedish).

The contrast between American and Swedish responses reveals a critical overlap of AI's utility in educational settings: while both groups acknowledge the potential of AI to enhance operational efficiency, the impact on pedagogical practices and educational outcomes diverges significantly based on systematic and cultural factors. In Sweden, the integration of AI is viewed through a critical lens that considers long-standing educational policies and practices, with a cautious approach towards how these technologies might influence the fundamental goals of education. Conversely, in the United States, there is an optimistic inclination towards employing AI to alleviate immediate administrative challenges, with a hopeful view toward its potential to enhance educational practices.

5.2 Fostering Engaging and Personalized Learning Environments

The narrative emerging from the research illustrates the potential of AIED to cultivate engaging and personalized learning environments has been widely acknowledged by educators, who envision AI as a catalyst for a more individualized and inclusive educational experience. Teachers have praised AI's ability to adapt learning processes to the unique needs of each student, thereby enhancing engagement and promoting a richer educational experience.

Participant C from the U.S. highlighted the significant impact AI could have in special education: *“Our whole goal is, from a Special Ed., perspective is that individualized education and being able to provide experiences for kids in an inclusive environment in the least restrictive environment,”* (Participant C, American). This notion of minimizing restrictions in learning environments resonates strongly across discussions, indicating a shift towards more personalized approaches that AI could facilitate. Similarly, Participant D from the U.S. reflects on the practical applications of AI, stating, *“I hear tons of people that you wouldn't necessarily think would be interested in trying new technologies or any digital tools be like, wow, I have a new ELL student, maybe I can utilize the AI to help them in the classroom,”* (Participant D, American).

Moreover, the enthusiasm for AI's role in education extends to fostering a safe and engaging learning atmosphere, as noted by Participant F from Sweden who is referring to a chatbot tool to facilitate learning and confidence among second language learners of varying levels: *“So this is amazing to see how the students are active and how they are engaged and they find it fun and they feel safe,”* (Participant F, Swedish). Such testimonials underscore the view among teachers that AI has the potential to make learning more dynamic and accessible and the potential that AIED tools can be used to engage learners of varying needs and learning journeys.

However, this optimistic outlook is tempered by substantial concerns regarding the implementation of AI for personalized learning, which include ethical, legal, bias, and access challenges. This digital divide, as Participant C explains, became glaringly evident during the COVID-19 pandemic: *“Thinking about what happened during COVID and access to the internet, when we all switched to our online learning, kids didn't have access to the same technologies,”* (Participant C, American). This concern is echoed by Participant D who acknowledges that *“there isn't an equality necessarily in education, at least in the United States. Everybody's offered an education, but the type of education and the quality of education varies town by town, region by region,”* (Participant D, American). This gap in access could potentially limit the effectiveness of AIED, reinforcing inequalities rather than alleviating them.

Ethical considerations also loom large, with concerns about data privacy, bias in AI algorithms, and the cultural appropriateness of AI tools, especially in global educational settings. Participant I's concern, *“I'm pretty concerned because I feel that there is a lot, a lot of people who do not take the ethical considerations in thought or have them in mind when they make decisions,”* highlights the critical need for ethical governance in AIED implementation (Participant I, Swedish). The fear of AI perpetuating existing biases is articulated by Participant H, who points out that *“all systems produced by humans are*

political, so there is no such thing as any unbiased system,” (Participant H, Swedish). A similar concern is emphasized by another Swedish participant who warns of a potentially troubling feedback loop: *“The current systems are trained on human data, things that we have said are written on the Internet. But very soon most of the text and the content of the Internet will be AI generated. So, the next generation will be trained on this generation's output and that will create a disturbing spiral,”* (Participant G, Swedish). This further highlights not only the inherent biases in these systems, but also raises questions about the future utility of AIEd as a pedagogical tool. The narrative drawn from the teachers’ insights provides a comprehensive view of both the opportunities and the hurdles that lie in integrating AI into educational systems, underscoring the crossroads between technological advancement and educational equity.

5.3 Augmenting Teacher Roles and Professional Development

AIEd holds the potential to transform educational environments by augmenting teacher roles and enhancing professional development, as noted by educators who envision AI not as a replacement for teachers, but as a powerful support tool. Participant F captures this optimism, seeing AI as a facilitator for more efficient teacher-student interactions and providing insights that help teachers focus their instructional efforts more effectively: *“From the teacher perspective, AI can be a guide, both for the student or as a teacher to know what the student knows and doesn't know. So, you can get guided as a teacher to know what to focus on in the next lesson.”* (Participant F, Swedish). This view is echoed by Participant C, who appreciates the AI-driven adaptations that facilitate inclusive education, noting the technology’s capability to *“make changes for students to access the curriculum easier,”* (Participant C, American).

The relief from administrative burdens is a particularly valued aspect of AIEd. As Participant C from America notes, *“So creative lesson plans, we say all the time here how we'd love to do more cross-curricular planning, but we just don't have the time in our schedule to be able to sit down and create those types of lesson plans. So maybe AI could even help us with that,”* (Participant C, American). This indicates a widespread sentiment among teachers that AI could free them from time-consuming non-teaching tasks, allowing them to focus on more rewarding educational activities and direct student engagement.

Participant G from Sweden discusses the nuanced potential of AI in education, emphasizing that while certain tasks could be automated to save time, it’s crucial to retain those that provide deep pedagogical value:

“At the same time, some tasks that are really dull, like doing assessment, also have other values to it. For instance, it's very crucial for a teacher to have good knowledge about what problems your students face and what they struggle with. That kind of knowledge is, to a large degree, attained by doing assessment. So, we have to be careful not automating those processes as well,” (Participant G, Swedish).

However, the implementation of AIEd is not without its challenges. Inconsistent leadership and a lack of comprehensive institutional support can stymie these technologies' effective integration into educational frameworks. Participant A underscores the impact of administrative instability on adopting new technologies: *“This school district for whatever reason seems to have a lot of administrative turnover...We've had a different principal or a different Superintendent almost every other year I've been here...there seems to be inconsistent school leadership,”* (Participant A, American).

Moreover, there seems to be a notable concern among educators about the adequacy of training and the overall preparedness to utilize AI effectively. Participant C from the U.S. provides a personal example of this problem by explaining a situation in which *“[administrators] are like, ‘we want you to start using*

this program.' But we don't have any training for it, but they want us to use it. We should be using it by the end of the month, and then they check in, 'hey, how's it going?' Well, it's not, because I don't know what I'm doing with it," (Participant C, American). This suggests a broader frustration felt by educators who are overwhelmed by an influx of digital tools introduced to them at the start of each school year. As another American educator explains:

"We always say it's too much and then every year, we get more programs to use. We get kind of petty about it and we say it's because we have a lot of supervisors in the district that it's a new supervisor just trying to make a little name for themselves. Like, 'oh, I found the next big thing.' So, when I read the scenarios, I was like, 'Oh god, what if this is the next one we have to learn...it's overwhelming," (Participant B, American).

This frustration was also shared among the Swedish participants as explained by Participant I. Regarding the implementation of a new digital tool for teachers, Participant I explains:

"It was very interesting to see how poorly [administrators] managed to actually implement this tool and educate people...and I feel that teachers are tending to fall into the negative perspective quickly because just the prospect of learning all this new stuff at the same time as you actually have to use it, but you don't know what you're doing...you have this steep learning curve and you don't get extra time from your principal to actually learn," (Participant I, Swedish).

This frustration regarding the many tools introduced to educators without proper training was expressed by all participants, Swedish and American alike. Furthermore, the discussions around the overwhelming nature of managing this large influx of digital tools led to some concerns shared by many participants from the U.S and Sweden that this will create an over reliance on AI by administrators. As one American explains: *"I could totally see admin choosing AI responses over teachers' thoughts because AI can give a standardized answer, admin always wants to teach to the test, kind of thing,"* (Participant B, American). This is further supported by Participant E who speaks from experience:

"I've seen firsthand how valuable our insights as teachers are in understanding and addressing the unique needs of our students. I've seen how admin often prioritizes data over our feedback already and I worry that [AI] would make this worse, you know, that admin would make decisions without considering the actual dynamics of a classroom. Like somehow an algorithm could better understand what my classroom is like over me. For example, I had a student who is very smart and participated in class, but they were failing because they weren't handing in their homework. On paper, an AI might say, this student needs a tutor, or you know, extra help. But I know this kid and I know his family and I know his parents are getting a divorce and things are rough at home. I just don't think AI could ever fully understand the human side of this job," (Participant E, American).

This emphasis on the lack of institutional support and fears of over-reliance on AI indicates a critical stressor educators feel that gets in the way of properly implementing digital tools into teaching practices. Teachers feel that their professional insights, developed through years of hands-on experience and personal interactions with students, could be more sidelined in favor of AI-generated data. They are concerned that administrators might favor the standardized, data-driven responses from AI tools over the nuanced, context-rich feedback provided by teachers.

However, despite these concerns, it is still recognized that successful implementation of AI into teaching practices requires full buy-in from administrators. This issue is made more complex as one participant elaborates on the necessity of administrative support and buy-in for successful AI integration:

"But institutional support in general, I think, is really important because sometimes we could get something from our administration down, but if the building principal isn't totally on board, they're not going to get the teachers on board and then the kids aren't going to be as on board with whatever type

of new learning program that they're using to support them. So, you need full administrative buy-in, in order to then trickle down to teachers and then have it be successful in the classroom," (Participant C, American).

This highlights a critical paradox: while teachers worry that administrators may over rely on AI, their support and full commitment are nonetheless essential for the effective integration of AI tools in education.

Participant F further underscores the divide between the potential and the current reality of AI in education, particularly emphasizing the disparity in readiness among teachers:

"There's going to be a big gap. You have these teachers running in front and trying all the different tools...So you have this group of teachers ahead and then you have most of the teachers already too busy with the normal tools and not have this extra energy to come over the threshold to just go into AI and really explore what you need to do," (Participant F, Swedish).

This gap is further complicated by the level of professional experience. Some of the participants noted observations that the level of professional experience a teacher has affects how willing those teachers are to utilize digital tools. This displays a certain resistance observed among experienced educators to adapt their teaching practices with the evolution of technology. One American participant notes that, *"I work with people that have been teaching almost 30 years and they're not really interested in really learning how to use a computer,"* (Participant A, American). This reveals a broader challenge in the integration of AI: bridging the gap between early adopters and those resistant to change. This is further evidenced by Participant E who shares that *"students can achieve great learning outcomes without being distracted by all these [digital tools]. We've done it for years with teaching that is hands-on, but doesn't require technology...If students are reaching objectives, then what's the problem?"* (Participant E, American).

However, one Swedish participant offers a different perspective noting that the more experienced a teacher is, the better equipped they are to use AI for planning lessons or assessing student work:

"If you're experienced you can see, 'Oh, this is a good lesson plan, I can use it.' But if you are new at your job, you don't have that knowledge. And the problem is, from my experience, it is those teachers that come out now that are fresh in their workplace that uses AI. It should be the other way around...people who are between 35-45 maybe are the best equipped because [they] have lived in both worlds and [they] have built their own computers. Whereas younger people, 15-25, they are served systems that work and when Wi-Fi goes out, they have no clue what to do," (Participant G, Swedish).

The integration challenges highlighted by participants continues as this perspective is further complicated by concerns raised by Participant H regarding the prevailing narrative around technology adoption in teaching:

"I'm very allergic to this kind of discourse about being at the forefront, you know, as if I accept digital innovations, then I am at the forefront. If I don't then I am at the back and that's not very constructive for teachers to have to align to this kind of discourse. That if you accept technology, it's good, if you don't accept the technology, then it's something negative, that you are trying to look backwards and it's something that is not desirable for society," (Participant H, Swedish).

This perspective indicates some resentment felt among certain educators that their teaching is only considered quality when they are measured by what current digital tools are utilized in their classrooms. Participant F offers a potential solution to this resistance by emphasizing the need for a balanced approach to integrating technology in teaching, advocating for the use of AI as one of several methods: *"We don't need either or. We have to use old methods as well. We need to integrate AI as one method*

among many,” (Participant F, Swedish). This statement highlights the importance of maintaining a diverse array of teaching methods, ensuring that the introduction of AI does not overshadow traditional, effective practices, but rather complements them. This approach encourages a more inclusive and flexible educational environment where technology enhances rather than dictates the teaching process.

These insights reflect a complex landscape where AIEd can dramatically enhance the teaching profession, making education more engaging and personalized. However, without addressing the underlying challenges of leadership, training and support, the promise of AIEd risks remaining unfulfilled.

6. Discussion

The results of this study have provided insights into teacher perceptions on the effects of AIED on productivity and workload in secondary education. In this section, the discussion of the results gleaned from the interviews with educators serves to weave together those insights with SCOT's concept of Interpretive Flexibility, particularly relevant in understanding the diverse perceptions of AIED among educators. This concept allows for the exploration into how American and Swedish educators differently interpret the utility and implications of AI technologies based on their unique educational frameworks and cultural contexts. Through these discussions, I aim to provide a holistic view of the multifaceted perspectives of educators on AI integration and the broader implications for policy and practice in educational technology. In summary, this discussion provides a comprehensive examination of the diverse perspectives and challenges associated with the integration of AIED, emphasizing the need for a balanced, inclusive, and participatory approach to the adoption of these technologies.

The revised scenarios are also included in this section to reflect the input and feedback from the interviews. The limitations of this study and some recommendations for future research are also briefly discussed.

6.1 Distrust in AI

Understanding the inherent distrust in AI among educators is important for grasping the broader challenges of AIED integration. The inherent distrust in AI among educators, as highlighted in the interviews, is multifaceted and deeply embedded in concerns about the political and cultural dimensions of technology. This distrust is primarily rooted in the understanding that AI systems, largely developed by major U.S. companies, carry biases that reflect their origins. These systems are not just technological tools but are imbued with specific cultural values and ideologies that may not align with the diverse educational contexts in which they are deployed. This concern is particularly poignant given that AI systems rely heavily on data that has been generated by humans — data that inevitably carries the biases and assumptions of those who produce it.

The concept of interpretive flexibility, as outlined in the Social Construction of Technology model by Pinch & Bijker (1984), provides a powerful lens for analyzing the multifaceted reactions to the integration of AI in educational settings. Interpretive flexibility suggests that technology is not a fixed entity with a predetermined trajectory or impact; instead, its meaning and function are shaped by the users' diverse social, cultural, and institutional contexts. This principle is particularly relevant in understanding the varying perceptions of AI among educators, as their background, values, and professional experiences significantly influence how they engage with and conceptualize technology.

In the context of AIED, interpretive flexibility allows us to see technology as a malleable construct, interpreted differently across various educational landscapes. For some educators, particularly those who might feel pressure from increasing class sizes and administrative demands, AI presents a promising solution for efficiency. Conversely, other educators perceive AI through a lens of skepticism and concern. Educators are not only concerned with how AI is used, but also with who controls this technology and for what purposes. This aspect of AIED taps into broader debates about data privacy, surveillance, and the commercialization of educational tools. Questions arise about whose interests AI serves – are these technologies primarily benefiting students and teachers, or are they tools for administrators and tech companies to exert greater control over the educational process? Such questions reflect a critical stance on the part of educators who are wary of technology being implemented without adequate regard for its long-term implications on educational autonomy and agency.

The literature on AIED often discusses the potential of AI to transform educational practices by personalizing learning and automating administrative tasks (Holmes et al., 2022). However, these discussions sometimes overlook the deeper implications of how AI is integrated into educational settings. For instance, UNESCO (2019) acknowledges the limitations of AI due to its inability to fully replicate or replace the human aspects of teaching. These include the ability to connect with students emotionally, foster creativity, and engage in complex social interactions. Based on these limitations, UNESCO (2019) recommends that AI should be integrated into education carefully and thoughtfully, rather than being adopted too quickly or without consideration of its limitations.

Similarly, a study by Tuomi et al. (2023) highlights the shift from knowledge-based AI systems to more advanced, data-driven models, which brings new challenges, including the management of biases and the need for transparency. Therefore, the concern that AI might soon operate on data generated by previous AI systems, creating a feedback loop that distances the educational content from human oversight, touches on a critical issue raised in the literature regarding the source and control of AI-generated content. This notion of a “disturbing spiral,” as previously expressed by Participant G from Sweden, where AI becomes self-referential and potentially detached from human-led educational values and contexts reflects concerns shared from the literature’s often cautious portrayal of AI’s capabilities (Aflalo, 2014; Baker et al., 2019; Hanushek & Etema, 2017; Pham & Sampson, 2022; Puttick et al., 2015).

Practically, these insights emphasize the need for policies that foster transparency in how AI systems are designed and used in educational settings. Educators must be involved in the development processes to ensure that AI tools are culturally sensitive and pedagogically sound. This involvement can help mitigate the risks associated with AI’s inherent biases and promote a more equitable and effective use of technology in education.

Understanding the distrust among educators toward AI through the lens of interpretive flexibility reveals a relationship between technology and the sociocultural dynamics of educational environments. By comparing these findings with existing literature, it becomes evident that while the potential of AI to enhance education is significant, the concerns regarding its integration are equally substantial. This duality suggests that the implementation of AI in educational settings requires careful consideration of how these technologies are introduced, integrated, and controlled. It calls for a participatory approach where educators are not merely recipients of new technologies, but are actively involved in shaping how AI is used in the classroom. This involvement ensures that AI tools are developed and deployed in ways that truly enhance educational outcomes while respecting the pedagogical values and cultural contexts of the teaching environment.

This discussion transitions into the next section which examines how educational productivity is impacted by the integration of AI, further highlighting the complexities and challenges faced by educators.

6.2 Educational Productivity and AI

Educational productivity is a critical aspect influenced by the integration of AI, reflecting both opportunities and challenges as highlighted by educators. The apprehension surrounding how productivity is measured in education, especially with the introduction of AIED tools, is a significant aspect of educator concerns. This is fundamentally tied to the broader discourse on what constitutes productivity in educational settings and the potential for AI to influence these metrics, often detrimentally.

Educators have expressed concerns that AI tools might focus overly on quantifiable outputs, such as test scores and task completion rates, which can misrepresent the true educational progress of students. This emphasis aligns with broader economic models of productivity, where outputs are typically straightforward and measurable. However, as Hanushek & Ettema (2017) point out, educational productivity is inherently complex and should not merely focus on output efficiency, but also on the quality and depth of learning. For instance, one educator's experience with digital textbooks incorporating AI for real-time feedback illustrates a shift in student behavior: students focused on quickly obtaining the right answers to complete more tasks, rather than engaging deeply with the material. This scenario echoes the broader worry that classrooms may appear to be working efficiently from a quantitative perspective, but that students are not really learning and becoming critical thinkers. Such insights reveal the limitations of current productivity metrics in education, which often fail to capture the nuances of learning processes and outcomes.

Through interpretive flexibility, we can construct educators' alternative interpretations of AI, through the opportunities, problems and conflicts they perceive. While some educators see the potential for AI to enhance efficiency and streamline processes, others perceive these same technologies as a threat to educational depth and student engagement. This dichotomy can be seen in the varying reactions to AI's role in monitoring and assessing student progress. As one participant noted, the constant oversight by AI tools led to a surface-level engagement by students, who felt pressured to perform tasks quickly rather than correctly or thoughtfully.

The literature suggests that while AI can indeed augment educational practices by automating routine tasks and personalizing learning (Holmes et al., 2022), there is a critical need to balance these benefits with the potential pitfalls of overemphasizing quantifiable metrics. For instance, Hanushek & Ettema (2017) discuss the challenges of measuring educational productivity, highlighting that a focus on output measures like test scores can obscure more significant educational goals, such as critical thinking and deep understanding. Moreover, the literature underscores the necessity for AI tools to support, not replace, the pedagogical goals of education (UNESCO, 2019). The concerns raised by educators in the interviews reflect a broader skepticism about whether AI can truly meet these pedagogical needs without compromising the depth of learning, a sentiment that challenges the more optimistic views presented in some educational technology literature (Roll & Wylie, 2016).

The discrepancy between the theoretical capabilities of AIED tools and the practical concerns of educators suggests a need for a more nuanced approach to integrating AI into educational settings. SCOT's concept of interpretive flexibility can shed light on why different stakeholders might perceive AI's effect on productivity differently, influenced by their specific institutional settings, personal experiences, and pedagogical philosophies. For example, school administrators might view AIED as a means to efficiently manage large volumes of student data and improve reporting accuracy, aligning with their administrative goals. Conversely, teachers might see AIED as a tool that, while potentially useful, could detract from the complex understanding of individual student learning paths and needs, thus promoting a more superficial form of learning that is heavily dependent on quantitative metrics like test scores and completion rates.

The concerns highlighted by educators underscore the need for reassessment of how productivity is measured and enhanced in educational contexts. Moreover, as educators articulate concerns over who controls AI technologies, they are also questioning the broader political and economic forces that shape these technologies' deployment in schools. They are wary of a shift where educational technology is driven more by commercial interests and standardized testing mandates than by pedagogical effectiveness and educational equity.

This discussion highlights the importance of ongoing dialogue and collaboration between educators, technologists, and policymakers to ensure that AI tools serve the broad and diverse needs of the educational community. The goal is to encourage the design of AI tools that support deep learning and

critical thinking, rather than merely reinforcing existing assessment metrics that may not accurately reflect student learning and engagement. Next, we will explore the misalignment in motivations for using AIED, shedding light on the differences in perspectives between teachers and administrators.

6.3 Misalignment in Motivations for Using AI in Education

The integration of AIED reveals a significant misalignment in motivations between teachers and administrators, impacting its effective implementation. An additional layer of complexity in the integration of AIED is the misalignment between the motivations of different stakeholders, particularly teachers and administrators. From the interviews, it appears that teachers are primarily interested in using AI to make education more dynamic and inclusive, addressing the diverse needs of their students and alleviating tedious tasks from their workload. In contrast, according to teacher perceptions, administrators often view AI as a tool to track student progress and achieve efficiency, which can help petition for more funding and resources from the government. This misalignment can create significant challenges for the successful integration of AI in educational settings.

The interviews with educators indicate a clear distinction in the perceived value of AI between teachers and administrators. Teachers emphasized AI's potential to reduce their workload and enhance personalized learning. For example, one American teacher discussed the heavy workload they experience in their job and emphasized that any task taken off their plate would save them significant time (Participant C, American). This sentiment was echoed by another participant who highlighted the potential for AI to handle routine tasks, such as scanning test reflection forms and sending parent emails (Participant B, American). These insights align with the broader literature on educational technology, which underscores AI's capacity to automate administrative tasks and free up teachers' time for more meaningful educational activities (Holmes et al., 2022).

In contrast, the findings also highlighted concerns among Swedish educators about AI's potential to perpetuate a system overly focused on quantifiable results rather than educational depth. Participant H from Sweden expressed concern that AI might exacerbate existing pressures within educational systems that prioritize financial outcomes over educational quality: This perspective aligns with literature, particularly Susskind's (2024) who warns of the unintended negative consequences of focusing narrowly on single metrics like GDP, or in this case, educational productivity (Susskind, 2024).

This misalignment in motivations also highlights a critical issue in the implementation of AI in education: the need for a participatory approach that involves educators in the decision-making process. The data from the findings indicate that teachers feel undervalued when their expertise is sidelined in favor of data-driven decision-making. A participant from the U.S. encapsulated this sentiment by sharing an experience where administrative decisions favored AI-generated data over teacher feedback. This overemphasis on data-driven approaches can lead to a devaluation of teacher expertise and a reduction in the quality of education. Teachers' nuanced understanding of their students' needs, which is developed through years of hands-on experience, cannot be fully replicated by AI systems. This concern is supported by the literature, which emphasizes the importance of human judgment in educational settings and warns against an overreliance on automated systems (UNESCO, 2019).

Through these insights, we can gain a better understanding of the perceptions of teachers as well as the complexities and challenges of incorporating AI into educational settings. The use of AI to enhance educational productivity without compromising quality requires a more nuanced understanding. In addition, teachers and administrators need to align their motivations for integrating AIED tools. If teachers feel that a digital tool does not provide a valuable, pedagogical use to their classrooms or if they feel these digital tools are being used in favor of teacher insights, then AIED tools are likely to be abandoned (Aflalo, 2014; Baker et al., 2019; Uygun, 2024).

Incorporating these insights into policy and practice can help mitigate the risks associated with the misalignment of motivations for using AI in education. By creating a more inclusive and participatory approach to AI integration, it is possible to enhance the effectiveness of these technologies and ensure that they truly serve the needs of students and educators. This approach aligns with the broader literature on educational technology and productivity, which emphasizes the importance of considering both quantitative and qualitative aspects of education (Hanushek & Ettema, 2017; Susskind, 2020).

Understanding the diverse motivations for using AI in education leads us to examine the practical challenges and the importance of achieving buy-in from all stakeholders, as discussed in the next section.

6.4 Implementation Challenges and Buy-In for AIEd

Implementing AIEd presents numerous practical challenges and requires comprehensive support and buy-in from all stakeholders. In addressing the practical difficulties of integrating AI in decentralized educational systems, it becomes evident that the full benefits of AI cannot be realized without comprehensive support from all stakeholders involved — leadership, teachers, parents, and even the students themselves. The essential challenge highlighted in the interviews is the discrepancy between the potential of AI to streamline education and the practical implementation hurdles that hinder its effective integration.

Decentralized educational environments, as described by the interviewees, tend to suffer from fragmented decision-making processes and inconsistent leadership, which complicates the deployment of digital tools. The lack of a centralized decision-making authority often leads to inconsistent adoption and implementation of new technologies across different parts of the system. This inconsistency can be detrimental to leveraging AI's full potential, as noted by one Swedish participant who highlighted the difficulties posed by principals who are tasked with too many responsibilities leading to an over reliance on AI responses (Participant G, Swedish).

These observations connect deeply with the literature, which emphasizes the necessity of aligning technological tools with the educational framework and strategic goals. For instance, Hanushek & Ettema (2017) discuss the importance of not only providing resources, but also ensuring these resources are effectively utilized to enhance productivity. Additionally, Pham & Sampson (2022) highlights that the integration of AIEd into classrooms cannot be seen as a simple technological transition, but a cultural and pedagogical one. This aligns with the need for strategic leadership in education that embraces AI and actively works to integrate it in a manner that supports educational goals and overcomes the inherent resistance to change.

Moreover, the literature review and results underscore the necessity for adequate training and support for educators to utilize AI tools effectively (Puttick, et al., 2015; UNESCO 2019). The lack of training and the rapid push for technology adoption without adequate preparation can alienate educators, potentially leading to underutilization or misuse of AI technologies. This challenge is highlighted by the consistent call from educators for more support and training, reflecting a critical gap in current educational technology strategies.

The divergence in perspectives on AI's role in education aligns with broader societal debates about technology and automation. For example, the literature highlights the view of AI's capability to automate administrative tasks and personalize learning, as seen in the works by Holmes et al. (2022) and UNESCO (2019). However, these optimistic perspectives often clash with the ground realities where educational leaders struggle to implement these technologies effectively due to structural and resource constraints.

Additionally, social backgrounds and professional experience are significant factors that influence educators' willingness to embrace new technologies. Younger and less experienced teachers might be more open to integrating innovative tools into their pedagogy, assuming these tools align with their digital native experiences and educational training focused on technology use. In contrast, more seasoned educators might display reluctance towards AI tools, as changing long-established teaching practices can be daunting and may be seen as unnecessary or risky. This dichotomy was evident in the interviews, where a veteran American educator expressed disinterest in adapting to new technologies, highlighting a common barrier to AI adoption: the inertia of established habits and skepticism towards the actual benefits of AI in enhancing educational outcomes. On the other hand, a Swedish educator noted that those who are 'in between' — neither too new nor too seasoned — might be the best positioned to leverage AI effectively due to a balanced exposure to traditional educational methods and new technologies.

To overcome these challenges, there is a critical need for strategic leadership within educational systems that can foster a conducive environment for AI integration. Educators and school administrators must work together to design processes that support consistent and effective AI adoption, tailored to the unique needs of their educational settings. Such processes should not only focus on technological integration, but also on building the human capacity, through training and support, to leverage these tools effectively.

As we move forward, it is essential to consider the dichotomy of technology adoption in education, recognizing the varying attitudes and experiences among educators, which is the focus of the next section.

6.5 The Dichotomy of Technology Adoption in Education

The adoption of new technologies in education reveals a dichotomy among educators, impacting their attitudes and effectiveness in utilizing these tools. Gleaned from the interviews, a dichotomy emerges between those who adopt new technologies and who are seen as pioneers, and those who resist and are viewed as lagging behind or outdated. This scenario places significant pressure on educators, creating a polarized environment where the use of technology can become a symbol of pedagogical identity and status rather than a tool for enhancing educational practices. Teachers who adopt new technologies are often praised and considered progressive, while those who are hesitant are viewed as resistant to change or less competent, irrespective of their pedagogical effectiveness or the actual benefits of the technology in question.

Using Interpretive Flexibility, we can see that teachers' attitudes towards AI and other digital tools are influenced by a variety of factors, including personal beliefs about teaching, professional autonomy, perceptions of the technology's effectiveness, and integration support systems. Their alternative interpretations generate different challenges to be addressed. For example, a teacher who values direct interaction with students might view AI tools that automate communication or assessment with skepticism, fearing a loss of personal connection with students. Conversely, a teacher overwhelmed with administrative tasks might welcome these same tools as a relief that allows more time for student interaction.

The literature review supports this interpretation by discussing both the potential benefits and the concerns associated with AIED. Studies like those by Holmes et al. (2022) highlight the administrative efficiency AI can bring, which aligns with the views of 'pioneers.' Conversely, critical perspectives from UNESCO (2019) and Tuomi et al. (2023) reflect concerns about AI replacing essential human elements of teaching, resonating with "traditionalist" views. This divergence is particularly evident in discussions around AI's role in personalizing education versus its potential to dehumanize the educational processes by reducing students and teachers to data points — a central tension that

Interpretive Flexibility helps to explain. Different educators will prioritize different aspects of their professional roles and thus see the value of AI through different lenses.

Addressing these challenges may require institutions to adopt flexible policies that allow teachers to choose how and when to integrate technology based on their pedagogical needs and professional judgment. This approach respects individual teacher autonomy and acknowledges the diverse educational contexts in which they operate. Additionally, from the interviews, it can be concluded that there is a dire need for a comprehensive support system. School districts should provide robust training and support for new technologies to reduce anxieties. These programs should not only teach the technical skills, but also address pedagogical integration, helping teachers see how technology can genuinely enhance their teaching without compromising their values. Additionally, there is a desire among educators to be included in the decision-making process about which technologies are adopted which can ensure these tools meet the needs of educators and students, enhancing buy-in and reducing the stigma associated with non-use. Lastly, efforts could be made to shift the cultural perception of technology use in education from a marker of status to a genuinely optional tool for enhancing education. This shift requires changing narratives around technology from being a requirement for modern teaching to being one of many tools available to educators.

This understanding of the dichotomy in technology adoption leads us to the final section, where we will explore revised scenarios based on the feedback and insights gathered from educators, offering a vision for the future integration of AIED.

6.6 Revised Scenarios

The preceding sections of this thesis have detailed the extensive exploration of educators' perspectives on the implementation of AIED. These findings have served as a crucial foundation for revisiting the initial scenarios presented to the interview participants, leading to their comprehensive revision. These refined versions of the future scenarios are reconstructed to more closely align with the feedback received and the broader social, cultural, and political contexts influencing educator perceptions. The revision process employed the method of visioning which is an ethical component of strategic futures thinking as described by Inayatullah (2013). By employing this method, the revised scenarios aim to serve as both a narrative tool for engaging stakeholders and a strategic guide for stakeholders to envision and achieve preferred futures in AIED.

Visioning has allowed for creation of future scenarios that reflect the collective aspirations and concerns of educators regarding AIED. These visions then set the stage for backcasting, a method that involves working backwards from these envisioned futures to identify the practical steps needed today to achieve these desired outcomes (Boulding & Boulding, 1995). This approach ensures that the scenarios are grounded in current realities and possibilities of AI technology and directed towards creating educational environments that are equitable, effective, and responsive to the needs of all students and teachers. By presenting these scenarios, educators, policymakers and technologists are invited to consider how AI tools can be designed and employed to enhance educational practices and outcomes.

Building on the insights gathered from the interviews, the following section will delve into the revised future scenarios which offer insights into the values and concerns expressed by educators.

6.6.1 Revised Optimistic Scenario (Projected to late 2020s/Early 2030s)

The educational environment has been transformed particularly in the experiences of Ms. Ortega, a devoted educator. With AI now supporting the streamlining of lesson planning and administrative duties, Ms. Ortega focuses her efforts on designing interdisciplinary lesson plans that integrate multiple

subjects enhancing comprehensive learning and promoting critical thinking skills. AI tools assist her in monitoring student progress and organizing her tasks, allowing her to spend more time engaging directly with her students and refining her teaching strategies.

In Ms. Ortega's classroom, AI's impact transcends administrative convenience, influencing assessment processes to support project-based learning that fosters creativity, collaboration, and critical analysis. AI tools assist Ms. Ortega by providing immediate feedback to students throughout the learning process in addition to Ms. Ortega's periodic, personalized feedback offered to students. This encourages a safe learning environment where students feel supported to explore ideas and learn from their mistakes, thus promoting intellectual growth. In her daily practice, Ms. Ortega uses AI to monitor student progress through a dashboard that offers detailed insights into each student's learning journey, allowing her to adapt teaching strategies effectively. This capability is instrumental in facilitating differentiated instruction, where AI analysts pinpoint individual learning needs.

To support this pedagogical shift, the district has embraced a proactive approach, not only technically, but also ethically. Comprehensive training on the ethical use of AI is provided, empowering teachers like Ms. Ortega to integrate technology thoughtfully within their teaching frameworks. This training emphasizes the use of AI as one of many tools, preserving teacher autonomy and promoting a balanced approach to technology use in education.

Facing the challenge of resource constraints, Ms. Ortega's district has fostered partnerships with local tech firms and universities to develop cost-effective, tailor-made AI solutions. These collaborations ensure the tools are accessible and culturally and contextually appropriate, mitigating biases and enhancing transparency. Moreover, the school leadership actively involves teachers in decision-making processes concerning digital tools, enhancing their agency, and ensuring the chosen technologies enrich pedagogical practices without supplanting teachers' insights. New educators are encouraged to gain substantial teaching experience before relying heavily on AI, ensuring they develop strong pedagogical foundations that are not overly dependent on technology.

Additionally, in trying to solve the issue of fragmented decision-making in decentralized education systems, Ms. Ortega's district has established a central advisory board. This board, comprising experienced educators from various schools, coordinates AI strategies across the district, ensuring consistency and fostering the sharing of best practices.

6.6.2 Revised Pessimistic Scenario (Projected to late 2020s)

By the late 2020s, the integration of AI into secondary education, though initially heralded as a means to lighten teacher workloads and innovate teaching practices, has not lived up to its promises for Mr. Bielke, a secondary school teacher. Instead of support, he finds himself navigating a landscape where the AI-driven transformation has aggravated existing challenges. Mandated to utilize AIED tools without adequate training or integration support, Mr. Bielke confronts a reality marked by the depersonalization of education and a significant disconnect from his students.

The automation of administrative and evaluative tasks by AI, far from easing his workload, has introduced a steep learning curve. Mr. Bielke grapples daily with tools that, while designed to streamline operations, fail to meet the nuanced needs of his diverse classroom. These systems, often encoded with biases, misinterpret the unique challenges faced by marginalized students, leading to a one-size-fits-all educational approach that falls short of equitable.

Moreover, the pervasive use of AI to monitor student activities in real-time, intended to track progress and customize learning experiences, instead pressures students to prioritize speed over depth in their studies. These AI tools have also been co-opted by administrators to quantify classroom productivity.

While these metrics may suggest high performance, these metrics often misrepresent the true comprehension and engagement of students. This focus on rapid, superficial learning undermines the quality of education, fostering an environment where meaningful engagement with material is rare.

Additionally, the reliance on AI for assessments and feedback distances Mr. Bielke from truly understanding his students' needs and progress. He observes a troubling dynamic where the administration, under the guise of efficiency, often prioritizes AI-generated insights over his professional judgment. This shift not only undermines his expertise but also signals a worrying trend: experienced educators are leaving the profession, disillusioned by their diminishing roles and the devaluation of their experience.

Amidst these challenges, Mr. Bielke also faces the narrative promoted by educational leaders that equating AI adoption with innovation is mandatory. This stance alienates many educators who value traditional, student-centered methods, which are increasingly side-lined in favor of technology-driven practices.

The decentralization of school management further complicates the scenario, with inconsistent leadership and frequent changes in digital tool adoption creating a chaotic environment. Teachers like Mr. Bielke feel overwhelmed by the continuous influx of new tools, each requiring adaptation without sufficient support or training. This inconsistency not only leads to burnout but also deepens the divide between those comfortable with digital transitions and those who are not.

As AI progresses rapidly, the bureaucratic structures of educational institutions lag, leaving educators and students to navigate a complex array of ethical, legal, and practical challenges. Mr. Bielke's experience underscores a critical oversight in the integration of AI in education: without thoughtful implementation, comprehensive training, genuine inclusivity, and respect for pedagogical expertise, the transformative promise of AI quickly becomes a profound burden, exacerbating the gap between the ideals of educational equity and the harsh realities of day-to-day teaching.

6.7 Limitations and Future Research

The study is not without limitations. Due to its small and possibly non-representative sample of educators from only two countries, it may not adequately capture global complexities and variations in AIED perceptions. Additionally, the evolving nature of AI technology means that perceptions and the technology itself are in a state of flux, which may alter the findings if the study were to be replicated in the future. Additionally, the rapid evolution of AI technology also means that the findings could quickly become outdated. Lastly, the scenario-based methodology used might encourage speculative rather than practical responses from participants.

To build on this research, future studies should consider a variety of enhancements. Expanding the scope of data to include a broader, more diverse group of educators worldwide would enrich the understanding of global perspectives on AI in education. Implementing longitudinal studies could shed light on how educator's perceptions and the use of AI evolve over time. Employing backcasting methodologies would also be beneficial, helping stakeholders identify practical steps needed to achieve desirable futures in education with AI (Boulding & Boulding, 1995). Furthermore, investigating the impact of targeted professional development programs could provide more insights into effective strategies for integrating AI into educational practices. It is also crucial to conduct studies on AI's ethical implications and equity concerns. Frameworks should be developed to ensure AI's application in education promotes fairness and inclusivity. Lastly, empirical research into the real-world implementation of AI tools in classrooms could assess their effectiveness in enhancing educational outcomes and identify practical challenges

faced by educators. Through these approaches, future research can offer more comprehensive guidance for the ethical and effective integration of AI into educational settings.

7. Conclusion

This thesis provides a thorough investigation into the integration of AI in secondary education, with a particular focus on educators' perceptions and its impact on educational productivity and workload. By employing a methodological approach that integrates speculative design with empirical research, this study explores deeper into the dynamic between the potential enhancements AI offers and the real-world apprehensions of teachers. These concerns center on the immediate functionalities of AI and its broader implications for pedagogical practices and equity in education.

The core of this research involved developing and analyzing scenarios that depict potential futures of AI in education – both optimistic and pessimistic. These scenarios served as a narrative tool to evoke and explore educators' thoughts and feelings about AI integration in their teaching environments. Interviews with educators revealed a dual perspective: while recognizing AI's potential to decrease administrative burdens and personalize learning, there is significant anxiety about AI's ability to execute these tasks without exacerbating existing inequities or undermining deep learning and teacher autonomy.

Educators expressed concerns that AI-driven approaches to boosting educational productivity often prioritize efficiency and standardization. This emphasis, they fear, could detract from more qualitative educational goals like critical thinking and student engagement. Such concerns highlight a critical tension between the potential of AI to streamline operations and the risk that its application in educational settings might instead deepen existing disparities and depersonalize the learning experience. Teachers worry that an uncritical adoption of AI focused on quantifiable productivity metrics might overshadow the nuanced aspects of teaching and learning, which include fostering intellectual curiosity and critical analysis skills among students.

This thesis aims to contribute to the field of educational technology by highlighting the nuanced perspectives of educators on AI integration. It provides insights for policymakers, technologists, and educational leaders on how to navigate the challenges associated with AI technologies. The study emphasizes the importance of including educators in the conversation about AIED, ensuring that their experiences and insights help shape the development and implementation of AI tools.

By showcasing the potential benefits and highlighting the concerns of AI from the educator's viewpoint, the research advocates for a balanced approach to AI integration. It calls for AI tools to be designed and deployed in ways that are ethical, transparent, and inclusive, enhancing rather than replacing traditional educational methods.

Moreover, the research highlights the need for ongoing dialogue and collaboration between educators, technologists, and policymakers. This collaboration is crucial to ensure that AI tools are used to enhance educational outcomes and address the concerns of those at the frontline of education. It also calls for a reevaluation of how educational productivity is measured, advocating for metrics that recognize deeper learning and critical thinking over simplistic output efficiency.

In concluding, this thesis advocates for continuous monitoring and evaluation of AI's impact on education, emphasizing the importance of adapting and refining AI tools to better align with the pedagogical goals and the diverse needs of learners. Future research should expand to include a broader and more diverse group of educators and should investigate the long-term effects of AI integration on educational practices and outcomes. As AI continues to evolve, this thesis serves as a foundational study that calls for ongoing monitoring and assessment of its impact on education. By maintaining a commitment to enhancing educational practices that are equitable, just, and conducive to fostering the full potential of all learners, the research sets a pathway towards a future where technology complements and enriches the educational landscape.

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Appendix A – Full Literature Review



Department of Applied IT & Department of Education, Communication and Learning

AIEd and the Quest for Productivity: Redefining Outcomes and Opportunities in Education

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Program and/or Course: International Master's Programme in IT & Learning/PDA685

Semester and Year: Autumn, 2023

Research Internship: The Missing Teacher in AI: Involving teachers in the meta-design of AI to ensure fairness

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Report Overview

At a time when Artificial Intelligence (AI) is permeating every facet of our lives, its integration into the education sector represents a paradigm shift with far-reaching implications. This report is structured into two distinct, but interconnected parts. Each part sheds light on different aspects of this integration. The first part presents a comprehensive literature review examining the impact of artificial intelligence in education (AIEd) on educational productivity. It explores how AIEd could potentially make education more efficient and effective. The second part details the insights and discussions from a workshop conducted at the 2023 WASP-HS conference in Malmö called “Living with AI in Education - Mapping Future Pathways,” which aimed to foster a deeper understanding of AIEd’s multifaceted ethical, legal, and social implications.

The two parts of the report, though distinct in their approach, are interconnected. The literature review provides the theoretical backdrop against which the workshop’s practical discussions are framed. Conversely, the workshop’s findings offer real-world validation and enrichment to the themes explored in the literature review. Together, they present a holistic view of AIEd’s role in transforming education, highlighting both its potential benefits and the challenges that need to be navigated.

Literature Review

Abstract:

This literature review examines the impact of Artificial Intelligence in Education (AIEd) on productivity within the educational sector and its influence on teacher job functions. As AIEd gains traction, its applications, ranging from intelligent tutoring systems to advanced predictive analytics, aim to enhance the learning experience and support educators. The review critically analyzes the multifaceted concept of productivity, traditionally characterized by output efficiency, yet in education, remains a contested variable due to the absence of a universally accepted measure of output.

Introduction:

In the evolving educational landscape, Artificial Intelligence in Education (AIEd) has emerged as a promising tool with the potential to transform the domain of teaching and learning. This literature review is an exploration of AIEd’s impact on productivity within education and its implications for the roles and responsibilities of teachers. As the intricacies of AI technologies are dissected, this review delves into their applications, ranging from nuanced support of the educational journey to proactive prediction of student outcomes.

The concept of productivity, particularly in the realm of education, is a complex one. Productivity traditionally measures the efficiency of output generation from given inputs. Yet, in the sphere of education, productivity transcends the simplicity of this definition. It

encompasses the effectiveness and efficiency of educational systems in achieving desired student outcomes, including both cognitive gains and the fostering of positive attitudes toward learning. The complexity lies in determining what precisely constitutes an output in education, a debate that remains unsettled within academic circles. Unlike industrial sectors where outputs can be quantitatively measured, educational outcomes resist simple quantification, as Hanushek and Ettema (2017) articulate, due to the multidimensional nature of educational aims and achievements.

Within this context, AIEd is poised to be a transformative influence on educational productivity. Its role extends from the reduction of time-intensive administrative tasks to providing analytics that can refine the educational process for the individual needs of students. AI-driven insights could empower teachers to tailor their instruction, which would potentially spark a new era of personalized education. Furthermore, AI could also act as a catalyst for teacher development, offering dynamic feedback mechanisms that enhance teacher methodologies.

Despite these advances, AIEd's impact on productivity in education is not straightforward. The absence of a universally accepted measure of educational output presents a challenge in assessing the true productivity gains attributed to AI technologies. The diversity of potential educational outcomes - from critical thinking and problem-solving skills to emotional intelligence and social awareness - complicates the task of evaluation. This review, therefore, approaches productivity not as a definitive metric, but as a spectrum of educational enhancements that AIEd may facilitate.

productivity. This investigation is important for assessing whether AIEd can bridge the gap between technological potential and actual educational outcomes, and how it can be aligned with the pedagogical goals and curriculum requirements

Research Questions:

This review centers around three critical questions designed to unravel the relationship between AIEd and educational productivity. These questions intend to explore the evolving dynamics in educational settings influenced by technological advancements.

AI in education: what is it and how is it used?

The first question explores the essence and application of AIEd. Artificial intelligence in education is a broad term encompassing a range of technologies and methodologies aimed at enhancing the educational experience. This question seeks to understand the various forms of AI technologies being utilized in educational contexts, examining their functions, capabilities, and roles in educational processes. This is an important exploration to understand how AI technologies are reshaping education, influencing pedagogical approaches, and the overall learning environment.

What is productivity? Productivity in education: how it is defined and where it comes from?

The second question goes deeper into the concept of productivity within the education sector, a notion typically associated with output efficiency in economic terms. The

question aims to understand the various interpretations and measurements of productivity in education, as well as their evolution in response to changing paradigms and societal demands.

How can AI affect productivity in education?

The final question addresses the core of this review - the impact of AIEd on educational productivity. This question examines the potential of AIEd to enhance various aspects of educational.

Methods:

Search Strategy (2.1)

This review aims to answer the overarching question: “How do Artificial Intelligence technologies affect productivity in education and teacher jobs?”. The review initiated with a comprehensive search strategy, outlining the scope and specifying keywords that would yield relevant academic and policy-related literature. The databases targeted for this search included prominent repositories such as SCOPUS, LearnTechLib, and various academic and governmental archives. The approach was designed to ensure a thorough and analytical review, adhering to the systematic guidelines of the PRISMA framework, which directed the selection and refinement of the literature to be included.

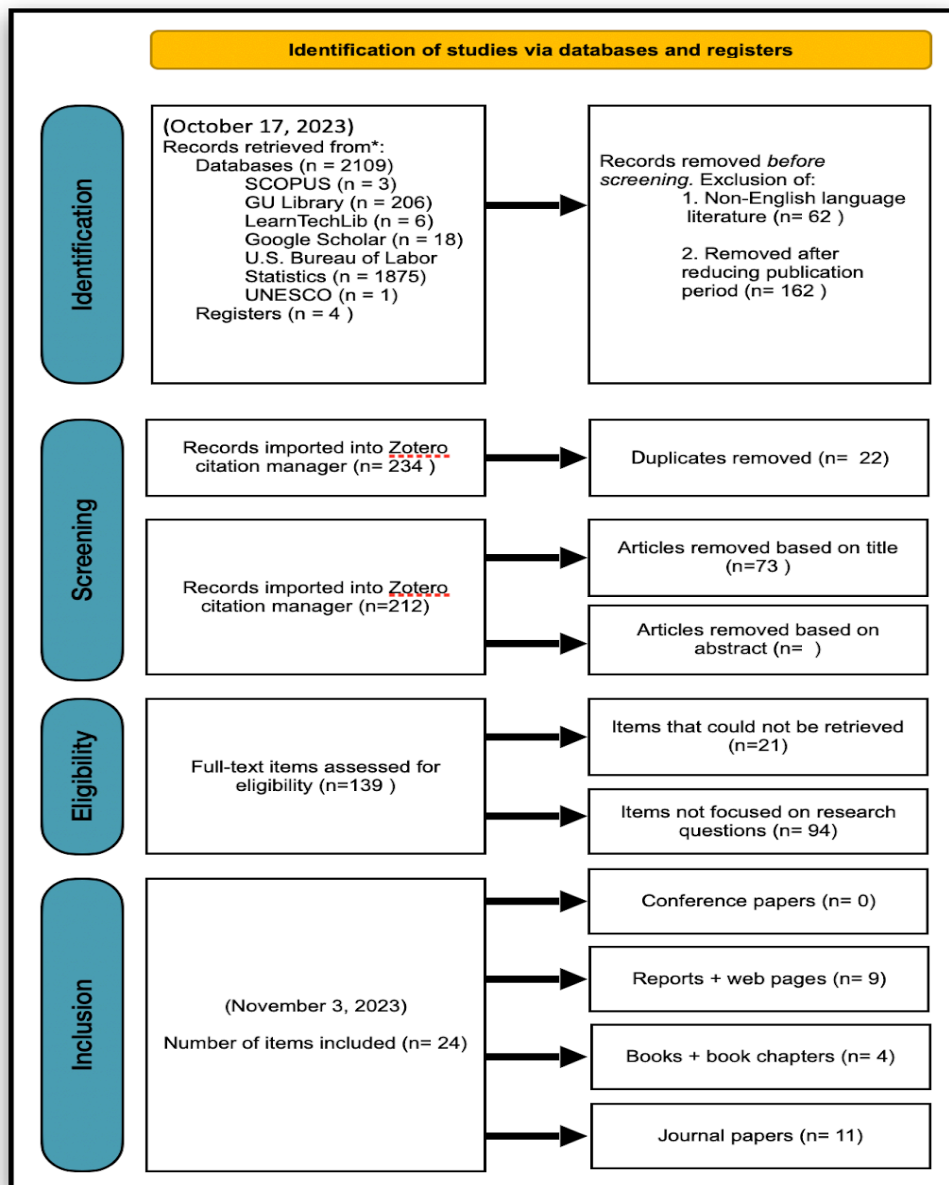


Figure 1 - Screenshot of PRISMA flowchart showing the sequential process for compiling the final corpus

Screening Process (2.2)

The initial search gathered an extensive list of 2109 publications, which underwent a rigorous screening process. Titles and abstracts were first examined against predetermined inclusion criteria, focusing on the direct relevance to AIEd, the teacher's role and educational productivity. Descriptions of how AIEd solely influences the student, studies conducted outside of Europe and The United States, and AI use without any associations within an educational context at any scale were excluded. It was decided that core terms such as "Artificial Intelligence in Education" (AIEd) and/or "educational

productivity” or close synonyms in the title or abstract were added to the corpus. Additionally, it was decided to limit the findings between 2014-2023, as a means to add breadth of understanding to applications of AIEd and current methods for measuring educational productivity. Key papers and selected items found before 2014 were included, as well. Peer-reviewed items in English encompassing primary and secondary research were included to ascertain reliability across the items in the corpus. This step was critical in filtering out irrelevant literature and setting the stage for a more focused review. The remaining articles were then subjected to a duplicate check, ensuring that each piece of literature was unique in its contribution to the review. Then, the remaining items were imported into Zotero Citation Manager system to exclude items based on title, abstract, and relevancy. The final screening iteration excluded items that could not be retrieved from the database, as well as items that were not focused on AI in educational contexts in the relevant geographical areas, resulting in the final 24 items included in the corpus.

Coding and Synthesis (2.3)

Subsequent to the screening, the selected articles were assigned codes to identify and categorize different aspects of the literature, such as resource identifiers, AIEd applications in teaching, AI’s influence on teacher skills, ethical considerations in AIEd, and methods for measuring educational productivity. The coding scheme was important for synthesizing a complex body of literature into coherent themes, providing a structured narrative on the interplay between AI technologies and educational productivity.

Limitations (2.4)

It is important to note that the review process, despite its systematic approach, was not without limitations. The search was restricted to English-language publications, omitting potentially valuable research in other languages. The challenge of establishing a consensus on educational productivity measurement methods was acknowledged, as varying practices across countries and the lack of a uniform metric complicated the task of quantifying AIEd’s impact. These constraints underscored the need for a critical interpretation of the results, with the understanding that the review’s findings represent a snapshot, informed by the selected corpus, of the broader discourse on AIEd’s role in shaping educational productivity.

Results and Discussion

AI in education: What is it and how is it used? (3.1)

AIEd is a multifaceted domain that incorporates various AI technologies to enhance the learning experience and improve educational practices. The field of AIEd has evolved from primarily relying on knowledge-based AI to incorporating more advanced, data-driven AI, including machine learning approaches. These advancements have brought about significant changes in how AI is applied in education.

Initially, AIEd was characterized by knowledge-based systems, where human experts had to define domain knowledge explicitly. This approach was particularly evident in intelligent

tutoring systems (ITS), which provided personalized learning experiences through individualized content sequencing and spacing (Tuomi, et al., 2023). However, the rapid advancements in data-driven AI have expanded the scope of AIED, introducing tools like generative AI, large language models (like Google's BERT and OpenAI's GPT-4), and dialog-based systems (such as ChatGPT and Microsoft's Bing Chat) (Tuomi, et al., 2023). These systems have significantly enhanced the capability of AIED tools to interact with users in more sophisticated and adaptive ways.

AIED is employed in various educational contexts, ranging from direct learner support to aiding teachers and administrative systems. It includes systems for personalized learning, automatic writing evaluation, learning analytics, chatbots, and tools to support learners with disabilities. AI is also used to streamline administrative tasks like recruitment, timetabling, and learning management (Holmes, et al., 2022). Despite its growing use in classrooms worldwide, the efficacy of learner-supporting AI tools, especially in well-resourced settings, remains a subject of debate, with some studies calling for more robust, independent evidence to justify their widespread adoption (Holmes, et al., 2022).

Interestingly, AIED's application is not limited to supporting students but extends to assisting educators. Recent research has focused on developing AI tools for resource curation, teacher practice analysis, time management, and course planning. However, the adoption of these technologies by commercial players and their widespread availability remains limited (Holmes, et al., 2022). Despite the potential of AI to automate routine tasks, it is widely acknowledged that AI cannot replace the essential role of teachers (UNESCO, 2019; Holmes, et al., 2022; Tuomi, et al., 2023, Richter, et al., 2019). The human mentorship aspect of teaching, along with the creative and socio-emotional elements, is beyond the scope of AI capabilities. Therefore, the development and integration of AI tools in education must be a participatory process, designed to support teachers rather than replace them (UNESCO, 2019).

The role of AI in education is not just about supporting current educational practices but also about transforming how learning is approached. AIED systems can construct adaptive and personalized learning experiences, making computational inferences that assist teachers in understanding optimal learning processes (Lameras & Arnab, 2022). This transformation aligns with the broader educational trend of moving from traditional didactic teaching to facilitating independent and collaborative learning (Roll & Wylie, 2016). In summary, AIED represents a significant shift in educational technology, offering tools that personalize and enhance learning experiences. While its potential to revolutionize education is considerable, the effective integration of AI in education requires a careful balance between leveraging technological advancements and maintaining the human-centric aspects of teaching and learning. AIED, therefore, stands not as a replacement for traditional educational methods, but as a powerful complement that can enrich and diversify the educational landscape.

Productivity in education: how is it defined and where does it come from? (3.2)

Productivity, fundamentally, is the measure of how much output can be generated from a given set of inputs. In the broader economic context, as discussed by Hanushek & Ettema (2017), productivity is a crucial indicator of economic health, representing the efficiency with which an economy or a sector can produce valued goods or services. It is

typically calculated by measuring outputs (goods and services) against inputs (such as labor, capital, and resources). The U.S. Bureau of Labor Statistics (BLS) details two types of productivity: labor productivity (output per hour of labor) and multifactor productivity (output per unit of combined inputs). The improvement in productivity is closely linked to technological advancements and innovations that allow for more output with the same or fewer inputs.

Applying this concept to the field of education, educational productivity is about measuring the outputs of the education system in relation to the inputs utilized. However, as Hanushek & Ettema (2017) point out, measuring productivity in education is more complex than in other sectors. Unlike the private sector, where outputs are often quantifiable goods or services that can be measured in monetary terms, educational outputs are more abstract, including factors like student learning, skill acquisition, and intellectual development. Traditionally, education hasn't focused much on productivity, often due to the difficulty in defining and measuring outputs. Historically, the focus in education has been more on improving outcomes (quality of education) without much attention to the costs or resources involved. However, with growing fiscal imbalances and budgetary pressures, there's an emerging need to consider productivity in education (Hanushek & Ettema, 2017).

Several approaches have been attempted to measure educational productivity. For instance, the Atkinson Report in the UK sought to measure government productivity in education by using government expenditure as the input measure and the number of full-time equivalent students as an output measure, with a quality adjustment based on national examination results (Hanushek & Ettema, 2017). Similarly, the BLS (2014) suggests that educational productivity can be assessed through various metrics, such as student-to-teacher ratios, graduation rates, standardized test scores, and average daily attendance, among others. However, no single measure can fully encapsulate all the costs and benefits of education. The complexity and multifaceted nature of educational outcomes make it challenging to develop a comprehensive measure of productivity in education. For example, the value of outputs relevant to immediate and long-term educational goals is not easily quantifiable. Moreover, the process of learning in education, as indicated by Fraser, et al., (1987), can be made more efficient through research, drawing parallels with growth industries. This implies that educational productivity encompasses not just the immediate academic outcomes but also the long-term cognitive and attitudinal development of students.

Educational productivity is also influenced by various factors as outlined by Walberg (1981, 1983, 1986), including student aptitude, instructional quality and quantity, and the educational environment. Each of these aspects is critical for effective learning, and large amounts of instruction or high degrees of ability could count for little if other aspects like student motivation or suitability or instruction are lacking. Therefore, productivity in education is a complex concept that goes beyond the simple measure of output versus input. It involves an intricate balance of various factors that contribute to effective learning and the overall development of students. While there is a growing need to consider productivity in education, especially in light of budgetary constraints and the goal for efficiency, the challenge lies in developing robust and comprehensive measures that can capture the full spectrum of educational outputs.

How can AI affect productivity in education? (3.3)

AIEd has the potential to significantly influence educational productivity, particularly concerning teacher workload and administrative efficiency. Examining the impact of AIEd in these areas involves understanding current challenges in resource allocation and exploring how AI can contribute to more effective and efficient educational practices. Firstly, it is important to acknowledge the existing inefficiencies in education. As noted by Hanushek & Ettema (2017), despite increased spending, mostly driven by higher labor costs and reduced class sizes, there hasn't been a corresponding rise in student outcomes. This disconnect between inputs (resources like labor and money) and outputs (measurable educational achievements) highlights a decline in educational productivity. The stagnation or decline in productivity, even with increased resources, suggests that the educational sector has not fully leveraged the potential efficiencies offered by technological advancements, including AI.

AIEd can address these inefficiencies by automating routine tasks and supporting teachers in non-instructional duties. For example, McShane (2022) illustrates that teachers dedicate significant time to planning, administrative tasks, and communication with parents. AIEd can streamline these processes, reducing the time teachers spend on non-teaching activities, as detailed in the survey by Hardinson (2022). By automating grading and providing feedback on student work, AI systems can free up substantial amounts of a teacher's workweek, allowing them to focus more on direct student engagement and personalized instruction. Additionally, AIEd can contribute to a more efficient allocation of educational resources. Hanushek & Ettema (2017) argue that simply providing more resources without changing how they are used does not consistently raise student outcomes. AIEd can optimize the use of these resources by enhancing teacher effectiveness and enabling personalized learning experiences for students. By supporting teachers with AI-driven tools for lesson planning, content delivery, and student assessment, AIEd can help shift the focus from quantity to quality in resource utilization.

However, the implementation of AIEd is not without challenges. The integration of AIEd in classrooms, as Pham & Sampson (2022) highlight, is not merely a technological transition, but also a cultural and pedagogical shift. Teachers' resistance to integrating technology, including AIEd tools, can stem from a deep-rooted commitment to conventional teaching methods, perceived inadequacies in technological competency, and concerns about the relevance of technology in enhancing educational quality. Aflalo (2014) noted that some educators believe meaningful learning can occur without digital tools, underlining a fundamental gap between technological potential and pedagogical acceptance. Additionally, technological integration is often hindered by teachers' perceptions and the divergence between technological planning and curriculum pedagogy. Teachers may not see the immediate benefit of AIEd for their students, leading to a lack of motivation to integrate these tools into their teaching practices. This resistance is exacerbated by the lack of adequate training and support for teachers to effectively use AIEd tools, as evidenced by the research gap in best practices for teaching with digital tools (Puttick, et al., 2015).

Furthermore, it is important to recognize that while AIEd can streamline administrative tasks and potentially enhance the efficiency of lesson planning and grading, its direct impact on student learning outcomes is less clear. The assumption that increased

technological integration will automatically lead to improved learning outcomes overlooks the complexity of educational processes (Hanushek & Ettema, 2017). As Baker, et al. (2019) indicate, there is a need for more rigorous testing of AIED tools in real educational settings to assess their efficacy. This testing should not only focus on the technological capabilities of AIED tools, but also on their pedagogical relevance and alignment with learning objectives. The effectiveness of AIED in improving learning outcomes also depends on the degree in which these tools are aligned with the curriculum and teaching goals. AIED needs to be seen not as a standalone solution, but as a part of a broader educational strategy that includes teacher training, curriculum development, and student engagement. The focus should be on how AIED can complement and enhance existing teaching practices rather than replace them.

Therefore, to bridge the gap between AIED's potential and actual improvements in learning outcomes, it is essential to address both the technological and human aspects of education. This involves creating a culture of technology acceptance and integration in schools, where teachers are not only trained in using AIED tools but are also involved in the decision-making process regarding technology adoption. In addition, professional development programs need to emphasize not just the technical aspects of AIED, but also its pedagogical applications, ensuring that teachers are equipped to integrate these tools effectively into their teaching practices. Furthermore, AIED tools should be designed with teacher and student feedback, ensuring that they meet the real needs of the classroom.

While AIED tools hold the promise of enhancing educational productivity, particularly in administrative efficiency and lesson planning, its impact on learning outcomes is contingent on successful integration into the educational system. This requires a collaborative approach involving teachers, technologists, and policymakers to ensure that AIED tools are effectively aligned with educational goals and are used as an integral part of a holistic educational strategy.

Personal Reflections

Throughout the course of this literature review, one aspect that continually intrigued me was the underlying emphasis on productivity within educational settings. Initially, I approached the topic of AIED with the expectation that its primary contribution would be enhancing learning outcomes and student engagement. However, as I went deeper into the research, I found a growing emphasis on quantifying education in the same way we would measure outputs from the private sector. This trend mirrors the broader societal shift which favors quantifiable efficiency and output. It is, therefore, unsurprising that these metrics have found their way into the education sector. This is evident in how university professors are evaluated based on their publication output or student enrollment figures. There is an implicit expectation that educators should not only impart knowledge, but also do so efficiently and prolifically. This expectation mirrors the productivity standards found in corporate and industrial contexts highlighting a compelling parallel between education and business sectors.

As I progressed through the literature, I found a complex situation in which the drive for productivity sometimes clashed with educational ideals. For example, the push for higher test scores, graduation rates, and publication outputs do not always translate into

improved learning outcomes or teaching quality. This contrast raises important questions about the core objectives of education and whether the current productivity metrics truly capture the essence of educational success. When education is treated as a business, there is a risk of prioritizing metrics like efficiency and output over these qualitative aspects of learning. The danger lies in potentially reducing education to a transactional process where students are seen more as products of an education assembly line rather than as individuals with unique learning journeys.

Furthermore, in regard to my research into how AIED tools could improve productivity in education, I found it noteworthy to consider the paradox that while these tools are intended to augment teacher roles, however, teachers often find themselves on the periphery of the design and decision-making process. Through my exploration of this topic, I was struck by the irony that tools designed to ease the workload of educators often end up being underutilized or abandoned completely. As suggested by the literature, one primary reason for this is the lack of teacher involvement in the development process of these tools (Lameras & Arnab, 2022, Pham & Sampson, 2022). When educators are not part of the design process, the resulting tools may not align well with their actual needs or realities of classroom dynamics. This misalignment can lead to a sense of disconnect where teachers feel that these tools, rather than being aids, become additional burdens or fail to integrate seamlessly into their established teaching methods. I suspect that this top-down approach to decision making regarding digital tools in education leads to resistance among teachers. This resistance may not be because of reluctance to embrace technology, but rather a response to being sidelined in decisions which significantly impact their professional practice.

Therefore, it is puzzling why, in an age where design emphasizes a user centered approach, developers only focus on the technical use of AIED tools and not on the realities of pedagogical settings and dynamics. Perhaps the problem with looking to the private sector to solve educational problems is that educational companies and the developers they employ aim for broad applicability to reach a larger market. This leads to a standardization of products that may not suit the diverse needs of educational environments. Customizing AIED tools for specific pedagogical needs would require a deep understanding of education, which is challenging and costly. Additionally, the commercial sector prioritizes innovative and rapid technological advancement with the goal of staying competitive and appealing to investors. However, the fast pace in which technology evolves outmatches the rate at which educational practices and policies can adapt. This is a huge disconnect between technology creation, adoption, and pedagogical utilization. It is, therefore, unsurprising that technical advancements often overshadow the critical need for pedagogical relevance of these AIED tools.

I also posed this question regarding policy making. If teachers are clearly identified as relevant stakeholders regarding the implementation of AIED tools, why are they not already part of the decision-making process? It would be easy to assume that, like most decisions in the private sector, it comes down to budget constraints. Perhaps, policymakers focus on cost-effective solutions without fully considering the pedagogical effectiveness or teacher training requirements. This could be combined with the bureaucratic structure of educational systems in which decisions are typically made at the higher administrative or governmental levels. This would likely create a disconnect between those making decisions and those who are directly impacted by them, like

teachers. Furthermore, I suppose there may be a perception among policymakers that technology decisions should be made by 'experts' in technology, rather than educators. In some contexts, there may even be cultural attitudes that view teachers as implementers of policy, rather than contributors to policy development. If true, I believe this perspective overlooks the crucial pedagogical insights that teachers can provide. As a result, bridging this gap will likely require not only a cultural shift but also a systemic shift in how educational policies and decisions are formulated and implemented.

Conclusion

This review delves into the relationship between AIEd and educational productivity, offering a comprehensive examination of how AIEd influences teaching methodologies and the broader educational landscape. The synthesis of the literature reveals significant insights into the potential of AIEd to enhance educational productivity, particularly in administrative efficiency and personalized learning, while also highlighting the complexities and challenges of integrating these technologies into traditional educational settings.

The review contributes to the existing body of literature by providing a balanced understanding of educational productivity in the context of AIEd. It underscores the multidimensional nature of educational outputs, which resist simple quantification, a challenge that AIEd aims to address through personalized learning approaches and predictive analytics. This exploration is pivotal in redefining how productivity in education is perceived, moving beyond traditional metrics of efficiency to encompass the quality of educational outcomes.

A key conclusion drawn from this review is that while AIEd holds significant promise in enhancing educational productivity, particularly in reducing teacher workloads and streamlining administrative tasks, its effectiveness in directly impacting student learning outcomes remains less clear. The review identifies a critical gap between the technological potential of AIEd and its pedagogical adoption. Teachers' resistance to technology, stemming from a reliance on conventional teaching methods and a perceived lack of necessary skills, emerges as a major barrier to the effective integration of AIEd tools. This resistance is not merely a technological hurdle but reflects a broader cultural and pedagogical challenge within the educational system.

Moreover, the insights gained from the workshop, "Living with AI in Education - Mapping Future Pathways," reinforce these findings. Participants' diverse perspectives, captured through PESTLE analysis, highlighted societal concerns, such as mental health implications and educational equity, and emphasized the need for ethical AI use and awareness of biases in AIEd systems. These discussions highlight the importance of considering AIEd's broader impact and the critical need for inclusive, participatory approaches in its implementation.

The review findings collectively highlight the necessity of rigorous testing and evaluation of AIEd tools in real educational settings. Assessments should focus not only on technological capabilities, but also on their alignment with pedagogical goals and curriculum requirements, involving both teachers and students. Successful AIEd

implementation requires a comprehensive approach that integrates technological innovation, pedagogical transformation, and cultural acceptance. Collaborative efforts among education, technologists, and policy makers are essential to ensure AIEd tools align with educational objectives and enhance, rather than replace traditional teaching methods. The future of AIEd in improving educational productivity lies in its thoughtful integration into an overarching educational strategy, positioning technology as a powerful tool in the hands of well-trained and supported educators, thereby enriching the learning experiences for students.

The reference list for this literature review is included in the thesis reference list.

Appendix B – List of Interview Questions

Introductory questions regarding AIEd:

1. Could you briefly describe your current role and responsibilities in secondary education?
2. What are your initial thoughts or feelings about the integration of AIEd?
3. [TEACHERS] Can you share any experiences you've had using technology to support your teaching? How does AI fit into this picture, if at all?
4. What are your expectations or concerns regarding the integration of AI into teaching and learning processes?
5. [TEACHERS] Does your workplace provide training or workshops to use digital tools in the classroom? Training for AI?
6. [TEACHERS] What is your school's current policy on AI? Do you think it is effective?

Transition to scenario-based questions:

7. Having read the two futuristic scenarios about AIEd's integration, what was your initial reaction? Did anything stand out to you?

Scenario-specific questions

8. Do these scenarios offer new understandings or valuable perspectives on the use of AI in education?
9. Based on your experience, how plausible do you find the technological advancements and educational practices described in these scenarios?
10. How well do these scenarios resonate with your own experiences or feelings about teaching in an AI-integrated environment?
11. Do these scenarios effectively present dilemmas or questions that provoke further thought about the role of AIEd?
12. How engaging and creatively written do you find these scenarios?

13. How effectively do these scenarios address ethical considerations surrounding the use of AI in the classroom?
14. How accurately and thoroughly do these scenarios explore the impact of AI on teacher roles, competencies, and student learning outcomes?
15. Do you have any suggestions for improving these scenarios to better reflect the complexities and challenges of integrating AI into education?

Concluding Questions:

16. Is there anything else you would like to add or comment on, either about the scenarios specifically or the role of AI in education more broadly?
17. Do you have any feedback on this interview or the topics we've covered today?

Appendix C – Informed Consent Form



Informed Consent for Master's Thesis Research

Title of Thesis: Strategising AI Integration: A Study on Educator Perspectives for Effective Policy and Design Development

Student Researcher: Brianne Rabel (gusrabbr@student.gu.se)

Supervisor: Dr. Marisa Ponti (marisa.ponti@ait.gu.se)

Aim of Thesis Research: The purpose of this research is to delve into how AIED can enhance educational productivity and alleviate the burdens of tedious tasks, allowing teachers to devote more time to engaging and mentoring students. Despite the potential benefits, it has been observed that digital tools intended to simplify teachers' work are often underutilized. This disconnect is attributed to the development of educational policies and tools based on assumptions by computer scientists and policymakers, rather than the actual needs and desires of teachers. This study seeks to bridge this gap by capturing the authentic voices and preferences of educators regarding AIED tools, with the ultimate goal of informing more effective design and policymaking.

Research Methods: This research adopts a hybrid approach, blending Futures Studies as conceptualized by Inayatullah (2012) with Speculative Design and fiction-based methodologies per Ross (2017) and Cox et al. (2023), to investigate the future of Artificial Intelligence in Education (AIED). Futures Studies' systematic exploration of potential futures through scenario development and trend analysis is combined with the imaginative narratives of Speculative Design and fiction-based research, facilitating a creative yet grounded examination of AIED's social, ethical, and cultural implications. This integrative method mitigates the time-intensive demands of traditional Futures Studies by leveraging Speculative Design's rapid scenario development and the fiction-based approach's engagement with complex technological issues, ensuring a robust and feasible exploration of AI's impact on educational productivity within the constraints of this study. Participants will interact with these scenarios to contribute their perspectives on the future roles and challenges of AI in education.

What you can expect: Your information will be kept confidential. Participants will be expected to read short, futuristic scenarios sent to them before a scheduled interview which may last up to 1 hour. Then, interviews will be conducted one-to-one via Zoom and recorded with your permission. During the interview, questions regarding your opinions, perceptions, and understandings of AI in education will be collected.

Period/Duration of Study: January 2024 - May 2024

References:

Cox, A., (2021). "The Coming "Intelligent University?" Exploring the Potential Impact of Artificial Intelligence (AI) and Robots on UK Higher Education. Society for Research in Higher Education.
https://figshare.shef.ac.uk/articles/dataset/AI_and_robots_in_Higher_Education_Eighteen_design_fictions/13139816/1

Inayatullah, S. (2012). "Futures Studies: Theories and Methods." *There's a Future, Visions for a Better World.* (pp.37-63). OpenMinds, BBVA Publishing. Spain.

Ross, J. (2017). "Speculative method in digital education research", *Learning, Media and Technology*, 42:2, 214-229, DOI: 10.1080/17439884.2016.1160927

* Required

Consent

Please carefully read points 1-13 before giving your consent below.

1. I have received sufficient information about the purpose of this study.

2. I am aware that I will participate in an interview to understand educator perspectives on AI integration in education.

3. I understand what is expected of me in this study.

4. I am aware that I will participate in an interview to understand educator perspectives on AI integration in education.

5. I consent to the interview being audio and video recorded.

6. My participation may involve risks or inconvenience:

Participation in this study involves minimal risk to participants. You may experience discomfort or emotional distress when reflecting on and discussing potential future scenarios and the implications of Artificial Intelligence in Education (AIEd). Engaging with speculative futures, especially those that may appear challenging or negative, might provoke unease. Additionally, the time commitment required for reading scenarios and participating in the interview (approximately 1 hour) may be inconvenient for some. Every effort will be made to ensure a supportive environment during discussions, allowing participants to express their views and feelings freely and without judgment.

7. Taking part in the study may provide the following benefits to me or others:

By participating in this study, you will contribute valuable insights into the development and implementation of AI in educational settings, potentially influencing future educational policies and tool design to be more aligned with teachers' needs and preferences. This engagement offers a unique opportunity for professional reflection and development, as you will explore and discuss innovative and speculative concepts related to AIEd. While there may not be direct personal benefits, your input can significantly impact the broader educational community by informing more effective and user-centered AI applications in education. Furthermore, this study aims to foster a deeper understanding among educators, policymakers, and researchers about the diverse perspectives on AIEd, potentially leading to more inclusive and effective educational practices.

8. My participation in this study is voluntary. I am aware that I can discontinue my participation at any time. I will not have to provide a reason for this and I will not suffer any disadvantages.

9. I understand that the researcher is not collecting sensitive data according to the General Data Protection Regulation.

10. The findings may be used for research purposes and may be published. My name will not be published; anonymity and confidentiality is guaranteed at every stage of the research project. The complete dataset can be made available to the research community in the anonymised manner described.

11. I will receive no payment for participating in the research.

12. I understand that for any complaints or other concerns about ethical issues relating to this study, I can contact GU's Council for Examining Deviations from Good Research Practice: rektor@gu.se

13. I can contact

the student researcher (see above for contact details)
the supervisor or advisor (see above for contact details)

for any questions or to exercise my rights (access to or correction of data, ...) after participating in the study.

14. **I have read and understand the information above and have received answers to all my questions regarding this study. I agree to participate in the study. ***

Yes

No

15. Today's Date *

Personal information

16. Full name *

17. Date of birth (Day/Month/Year) *

18. Email *

19. Which of the following best describes your current status? *

- Student
- Employed
- Unemployed
- Retired
- Prefer not to say
- Other

20. Do you have a professional history in teaching AND/OR involved in educational training within secondary education settings. This includes secondary school teachers, educational trainers, and educators with direct experience in designing or implementing curricular activities. *

- Yes
- No

21. Current Occupation *

22. Country of Residence *

23. I would like to be informed of the results of this research. The student researcher may contact me at the previously provided e-mail address. *

Yes

No