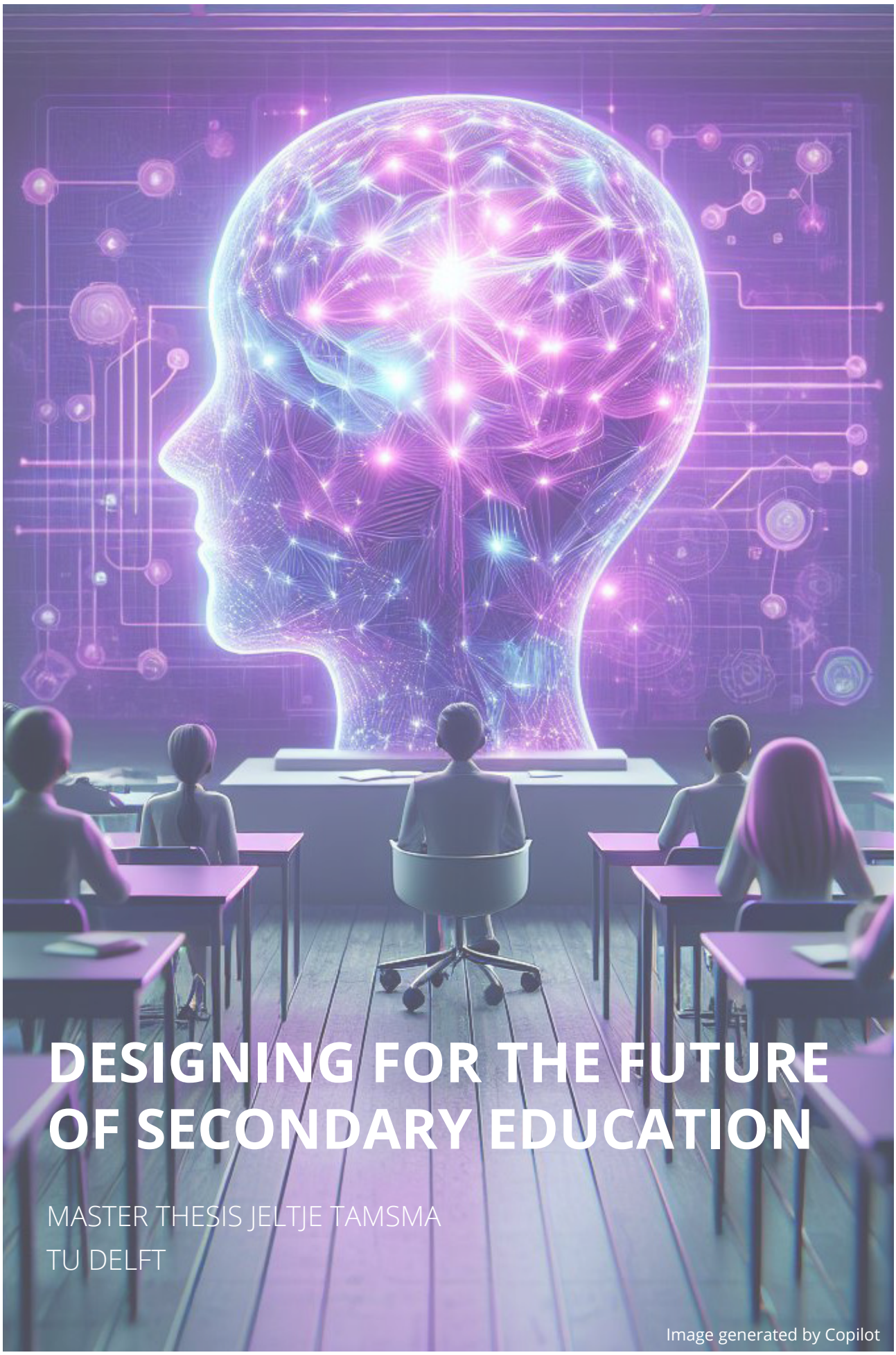


DESIGNING FOR THE FUTURE OF SECONDARY EDUCATION

MASTER THESIS JELTJE TAMSMA
TU DELFT

Image generated by Copilot

Colophon

Delft, May 2024

Thesis

Graduation project
Msc Design for Interaction
Faculty of Industrial Design Engineering
Delft University of Technology

Author

Jeltje Tamsma
Student Number: 4662628

Academic supervisors

Dr. Cila, N.
Dr. Lomas, J.D.

Project partners

Christelijk Lyceum Delft
Michiel van Zomeren

SCO Delft
Robert Lock

Preface

This thesis concludes my Master's degree in Design for Interaction at the Faculty of Industrial Design Engineering at TU Delft. Over the past seven years I've been involved in inspiring projects, always prioritising design for social and challenging issues. I believe it's our duty as designers to apply our skills to issues that need our help the most. While it's easy to let our personal opinions guide our design focus, society doesn't necessarily need a redesign of, for example, museum pathways. By listening to societal needs, I've developed designs related to menstruation, breastfeeding in public, and now to teachers overwhelmed by Generative AI challenges.

For the past six months, I've been immersed in the field of secondary education and Generative AI. It's particularly special to have done this project with my own secondary school, Christelijk Lyceum Delft, which marks a conclusion to my university journey, where my secondary school journey began. Despite personal turbulence during this time, I'm surprised by my ability to persevere and proud to have completed my thesis in the midst of these challenges.

Completing my graduation project would not have been possible without the help and guidance of my team. I would like to express my sincere gratitude to my supervisor, Nazli Cila, for her guidance and thought-provoking questions that facilitated effective reflection on my project. Our meetings always provided me with a clearer overview of the project. I would also like to thank my mentor, Derek Lomas, for his support and guidance whenever I encountered obstacles, particularly in navigating the complexities of Generative AI research.

I'm also grateful for the collaboration with SCO Delft and Christelijk Lyceum Delft. Special thanks to Robert Lock for introducing me to Christelijk Lyceum Delft. Next to that, Michiel van Zomeren has been an invaluable sparring partner throughout the project, providing direct contact with my user group and facilitating constant testing and feedback sessions with teachers, which have been instrumental in refining my project.

I would like to thank everyone who participated in my research through interviews, testing and creative sessions. I would also like to thank my family, friends, roommates and fellow students for their support throughout this journey.

Finally, to the reader, I hope you find the exploration of the world of Generative AI and secondary education inspiring and I hope you will be encouraged to explore Generative AI for yourself.

Enjoy!

Jeltje Tamsma

Abbreviations

AI = Artificial Intelligence
GenAI = Generative Artificial Intelligence
Christelijk Lyceum Delft = CLD

Definitions

Artificial Intelligence

Artificial Intelligence (AI) refers to systems that display intelligent behaviour by analysing their environment and taking actions – with some degree of autonomy – to achieve specific goals. AI-based systems can be purely software-based, acting in the virtual world or AI can be embedded in hardware devices (The European Commission's HIGH-LEVEL EXPERT GROUP ON Artificial Intelligence, 2018).

Generative AI

Generative AI is a form of AI that can create new and unique content (such as images, videos, audio, and text) based on a user's prompt by analysing vast amounts of existing data (Taulli, 2023). Generative AI requires good prompts before you can use it well (Universiteit Utrecht, n.d.).

AI prompting

AI prompts provide explicit instructions to an AI or machine learning model, enabling it to produce the desired outputs (Oppenlaender et al., 2023).

ChatGPT

ChatGPT is a form of GenAI that is called a Large Language Model (LLM). This means that it understands and generates text in a human-like fashion. It uses natural language processing to create human-like conversational dialogue. The language model can respond to questions and compose various written content, including articles, social media posts, essays, code and emails (OpenAI, 2022).

ChatGPT explaining itself:
I'm an AI language model designed to understand and generate human-like text based on the input I receive. Trained on vast datasets, I comprehend a wide range of topics, from science and literature to everyday conversations. While I can simulate human-like responses, I lack consciousness or emotions, operating solely on algorithms and data.

Executive Summary

While many students are already using ChatGPT to help them with their schoolwork, even to the extent of having ChatGPT write reports for them, the debate about whether students should have access to ChatGPT in secondary schools is still ongoing. Despite resistance from educational staff, ChatGPT is now firmly established in secondary schools and cannot be ignored. Therefore, this project aims to explore how Generative AI has been adopted in secondary education and how design can facilitate this adaptation process.

This graduation project was done in collaboration with SCO Delft and Christelijk Lyceum Delft (CLD). The foundation SCO Delft consists of seven primary schools (ten locations) and one secondary school (three locations). CLD is one of the schools under the SCO Delft foundation that was chosen as a focal point for this project. The school played a crucial role in facilitating communication with teachers and testing concept prototypes throughout the project.

In order to design for the future of education, research was conducted in both the current and future contexts of secondary education. In the current context, interviews were carried out with stakeholders such as school boards and educational publishers to understand how secondary education is adapting to ChatGPT. In addition, desk research was performed to gather insights from reputable sources such as the Ministry of Education and the European Parliament, focusing on discussions, policies and recommendations related to GenAI in education. Finally, the research included semi-structured interviews with teachers from CLD to understand the use and perspectives of ChatGPT among teachers and students in secondary education.

The research conducted in the current context highlights the consensus that human oversight is crucial when integrating AI into education. ChatGPT is recognised as a supportive tool for both teachers and students, providing valuable assistance. However, three key risks were identified: biases inherent in AI, the potential for GenAI to produce inaccurate information (referred to as hallucinations), and privacy concerns. At CLD, it was found that students often use ChatGPT inappropriately without understanding the risks involved. Teachers need to play an active role in guiding students to use ChatGPT responsibly and to educate them about these risks. However, classroom discussions about ChatGPT are rare, indicating a lack of recognition from teachers. In addition, teachers themselves rarely use ChatGPT due to time constraints and limited training in GenAI.

The understand the future context of secondary education, the Vision in Product Design (ViP) approach by Hekkert and van Dijk (2011) was used. This approach allows for designing for the unknown, a framework was developed focusing on four different mindsets that teachers may have. Semi-structured interviews with teachers at CLD provided insights into their values and perspectives and helped to identify which mindset best matched their views. The fourth mindset, characterised by a social and motivated outlook, resonated most with the teachers at CLD. Consequently, the design efforts were directed towards accommodating teachers with this mindset. However, it was crucial to recognise a significant constraint: teachers have demanding schedules and limited time to devote to new topics such as GenAI. Therefore, this consideration was taken into account when formulating the problem statements and design directions.

Based on the findings of the current and future context, a problem statement and design direction were proposed. The problem statement stated that teachers face challenges in developing knowledge and experience of GenAI due to their demanding schedules and unclear guidance from school management. Based on this problem statement and the identified teacher mindset, a design direction emerged. This direction prioritised fostering social interaction between teachers and students while educating both teachers and students on GenAI.

In the design phase of the project, creative sessions led to the identification of three desired concept qualities for the final design of this project: Out of the ordinary, Collaborative and Interactive. By applying a designing through-doing approach, concept prototypes were tested early in the process to allow for quick iterations of the concepts or the exploration of alternative directions (Rincón-Saavedra et al., 2019). Tests with the concept prototypes were conducted at CLD, involving multiple secondary school teachers recruited through surveys and email correspondence.

Testing of the first concept concluded that the final design should not be too Out of the ordinary, as non-traditional teaching methods did not provide students with the familiar guidance they needed. This resulted in students not acquiring the necessary GenAI knowledge as they paid limited attention during the test. This was therefore taken into account during the rest of the design phase.

As a result of the design-through-doing approach, two successful concept prototypes emerged: a lesson module and a website. Both aim to support teachers by providing resources on GenAI, minimising the time spent searching for information on it. The lesson module promotes dialogue between teachers and students to share insights and knowledge, while encouraging critical and responsible use of GenAI through exercises. The website provides knowledge about GenAI through videos, examples and practical guidance on how to use GenAI. Feedback sessions with teachers significantly improved both concept prototypes. Teachers expressed a high level of interest in both the lesson module and the website, indicating that their needs and expectations had been effectively addressed.

In order to integrate GenAI into secondary education by August 2026, a roadmap has been developed following the guidebook by Simonse (2017). CLD and SCO Delft are positioned as potential leaders in this endeavour, as they have gained valuable insights into GenAI and have access to the two concept prototypes developed in this project. They will use workshops and study days to share results with educators from other schools, fostering collaboration and knowledge sharing. Additionally, collaborative brainstorming and experimentation with teachers and students will identify effective GenAI applications in education. Finally, the findings from those experiments will be shared with school authorities and stakeholders across the country through the website.. Given the rapid evolution of AI, CLD and SCO Delft should regularly review and adapt the roadmap to ensure its continued relevance and effectiveness.

All in all, GenAI is becoming inevitable for students. This technology will reshape the way we work, underscoring the importance of teaching GenAI skills to the next generation. Students should learn how to use GenAI effectively, they should also be taught how to critique the results. Teachers have a vital role to play in guiding students in this use of GenAI. To address teachers' time constraints, the project proposed ready-made teaching materials and a centralised information platform. It also identified ongoing discussion, professional development opportunities and government regulation as essential elements for the integration of GenAI in education, with a focus on privacy and accessibility for all.

Table of Contents

Preface 4
Abbreviations 5
Definitions 5
Executive Summary 6
Introduction 11
1.1. Topic introduction 12
1.2. Problem definition and project goal 12
1.3. Design process 13
1.4. Project context 14
Research approach and methods 19
2.1. Current context approach 20
2.2. Future context approach 22
2.3. Conclusion 23
Current context 25
3.1. The current activity around ChatGPT in secondary education 26
3.2. Level of control and implementation of AI in education 26
3.3. Risk and opportunities of AI 28
3.4. ChatGPT usage and knowledge at CLD 30
3.5. Conclusion 33
Future context 35
4.1. The driving forces for the future of secondary education 36
4.2. Framework: The different mindsets of teachers 39
4.3. The mindset of teachers at CLD 40
4.4. Choosing a mindset 42
4.5. Conclusion 43
Design direction 45
5.1. Problem statement 46
5.2. Design direction 46
5.3. Conclusion 47
Design methods 51
6.1. Individual brainstorms and creative sessions 52
6.2. Design-through -doing 52
6.3. User involvement 53
6.4. Conclusion 54
Desired concept qualities 57
7.1. Out of the ordinary 58
7.2. Collaborative 58
7.3. Interactive 58
7.4. Conclusion 59
Concepts & Testing 61
8.1. Concept 1: Interactive online module 62
8.2. Concept 2: Lesson module 64
8.3. Concept 3: The website 74
8.4. Conclusion 81
Implementation 83
9.1. Vision 84
9.2. Shaping the roadmap 84
9.3. Horizons 86
9.4. Resources 87
9.5. Conclusion 88
Conclusion 91
10.1. Conclusion 92
10.2. Discussion 93
10.3. Recommendations 95
Reference 96
Appendix 106

01

Introduction

Chapter 1 provides an introduction into the topic of this graduation project. In addition, the problem definition, design process and project context are discussed.

1.1. Topic introduction
1.2. Problem definition, scope and user group
1.3. Design process
1.4. Project context

1.1. Topic introduction

Since the 1950's, computer scientists have been developing AI (Dasgupta et al., 2023). Up until now, many different types of AI applications have been developed. Think of virtual assistants such as Siri and Alexa, autonomous vehicles, customer service, face detection on your phone, etc.. Approximately ten years ago, a new form of AI was added to this list, called Generative AI (Y. Cao et al., 2023). GenAI is a form of AI that can create new and unique content (such as images, videos, audio, and text) based on a user's prompt by analysing vast amounts of existing data. In October 2022, the company OpenAI announced ChatGPT (OpenAI, 2022). The emergence of ChatGPT is seen as a turning point for GenAI, given its ability to provide users with different forms of written content (Taulli, 2023; Mollick, 2022). ChatGPT is a text-based GenAI, which means it can compose various written content. This content can differ per prompt, including articles, social media posts, essays, code and emails.

As of now, it's stated that AI has a disruptive impact, comparable to that of the steam engine, electricity, the internal combustion engine, and the computer (Ministerie van Algemene Zaken, 2021). Kennisnet, a company that ensures technology is utilised to improve the quality and accessibility of primary and secondary education while managing safety and ICT risks, stated that AI will touch upon every layer of the school in some way, see Figure 1. Kennisnet advocates an early discussion about AI in schools and among teachers, emphasising its permanent presence. In addition, policymakers assert that educators have a responsibility to develop strategies for integrating AI tools, such as ChatGPT, into the classroom environment (NOS, 2023).

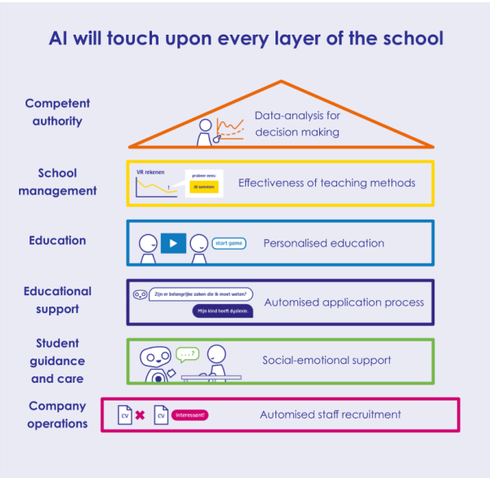


Figure 1: AI will touch upon every layer of the school (Stichting Kennisnet, 2023d)

1.2. Problem definition and project goal

In secondary schools, there's an ongoing debate about whether students should have access to ChatGPT or not (NOS, 2023a). Meanwhile, students are already working with ChatGPT to help them with their schoolwork and admitted to using ChatGPT to write full reports for them (Schellevis & Moerland, 2023). Whether schools and teachers want it or not, ChatGPT is already playing a role in secondary schools.

In parallel, secondary school teachers have not yet used ChatGPT and have reservations about its use in the classroom due to concerns about possible negative effects (SCO Delft, 2023). This reluctance suggests that teachers are not prepared to familiarise themselves with ChatGPT, let alone develop skills in its use. Nevertheless, teachers' reluctance risks placing them behind their students in terms of technological literacy and adaptability. Therefore, the main research question for this final project is formulated as: ***How has Generative AI been adopted in secondary education and how can design facilitate this adaptation process?***

The primary objective of this project is to develop a working prototype that will enable secondary school teachers to effectively embrace the emergence of GenAI in secondary education, thereby preventing them from being left behind by their students. Achieving this goal will require deep immersion in the secondary school environment and active engagement with users to ensure that the solution is closely aligned with their needs and requirements.

1.3. Design process

To achieve the project goal, it's crucial to first gain a comprehensive understanding of the current context of secondary education. Additionally, given the continuously evolving nature of GenAI (World Bank, 2023), it's imperative to consider the future trajectory of secondary education. Thus, the ViP (Vision in Product Design) method developed by Hekkert and van Dijk (2011) was employed. This method provides a framework for envisioning potential future scenarios and designing solutions that anticipate upcoming needs and challenges. By utilizing the ViP method, the project gained valuable insights into the future of secondary education, which informed the overall design direction and strategic approach of the initiative.

To illustrate the steps taken, the process is visualised in Figure 2. The project comprises of two phases: a research phase followed by a design phase. During the research phase, the current and future context of secondary education in the Netherlands were investigated. Based on the results of the research phase, a design direction was chosen. This was followed by brainstorming sessions to identify the desired concept qualities. A design-through-doing approach was used to test concepts early in the process, allowing for rapid iterations or exploration of alternative directions (Rincón-Saavedra et al., 2019). Feedback sessions, surveys and discussions with the user group were used to ensure user involvement throughout the design process. Inspiration was drawn from the Convivial Toolbox methods developed by Sanders and Stappers (2019), who both emphasise the importance of directly involving the people we design for in the design process (2019).

This collaborative design process allowed us to incorporate valuable insights and perspectives from the user group.

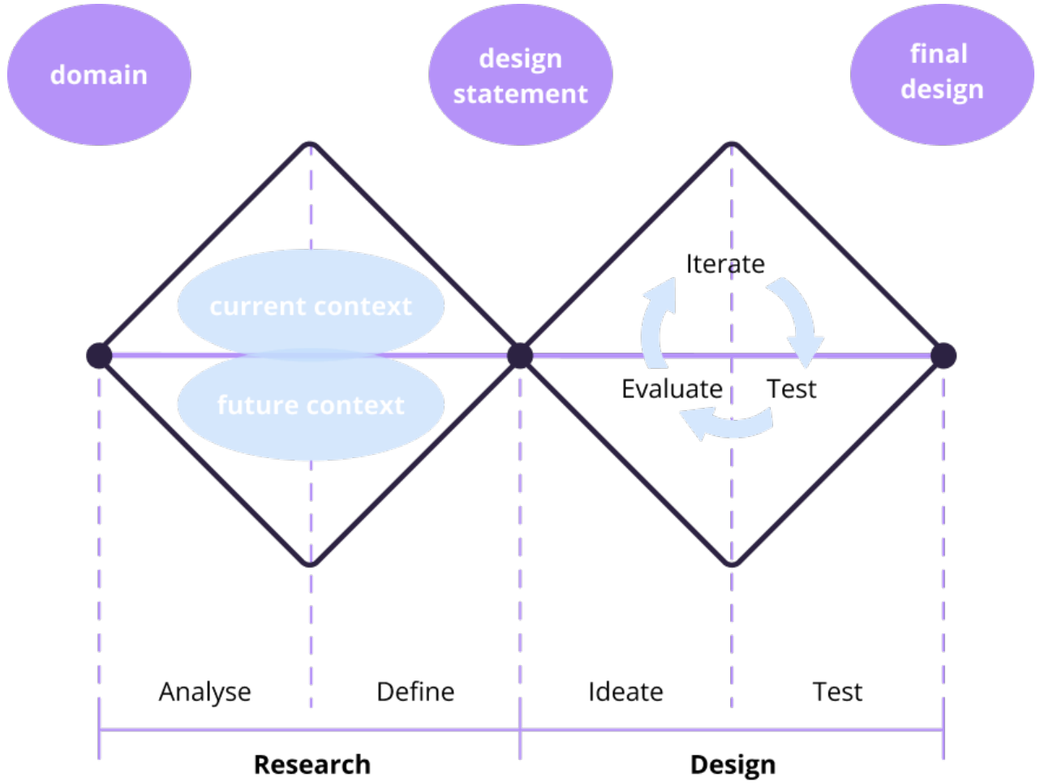


Figure 2: Chronically visualisation of the process

1.4. Project context

This graduation project is in collaboration with SCO Delft and CLD. The foundation SCO Delft consists of seven primary schools and one secondary school (three locations). SCO Delft creates policies to which all these schools must adhere. Policy is developed in close consultation with the directors of primary and secondary education. The directors have overall responsibility for the implementation of the policy and the school plan adopted for each school. One of the schools under SCO Delft is CLD, which was chosen as the focus for this final project. Consequently, this school played a crucial role in facilitating communication with our user groups, which are teachers, and testing concept prototypes throughout the project.

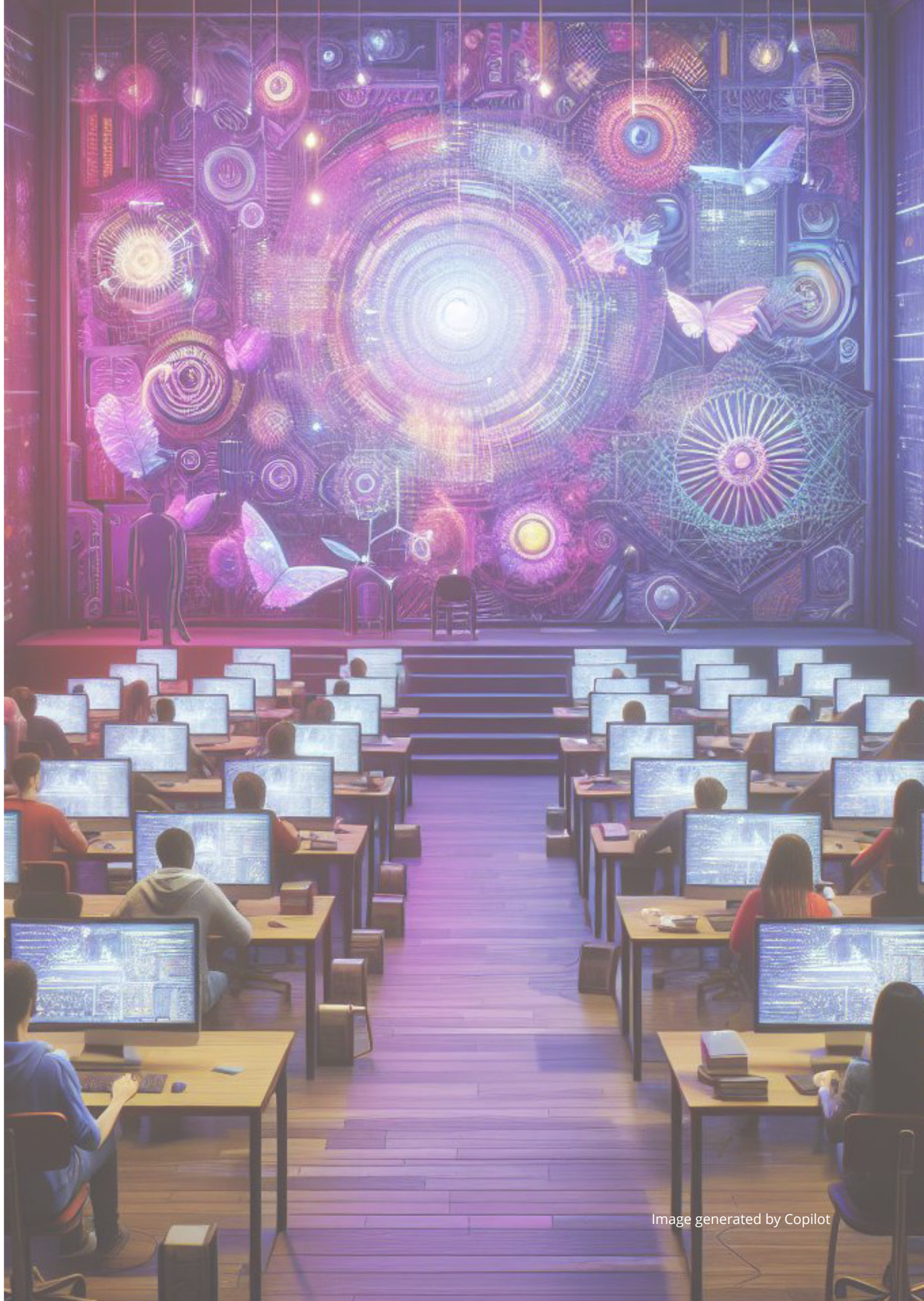


Image generated by Copilot

RESEARCH PHASE

Exploring the current and future context of secondary education

As mentioned in Chapter 1, the main research question for this graduation project states: ***How has Generative AI been adopted in secondary education and how can design facilitate this adaptation process?***

To answer this question, research was undertaken to gain an understanding of the current context of secondary education and to gather insights on the integration of GenAI into secondary education. The research methods included stakeholder interviews, desk research and interviews with teachers and students of CLD to gain valuable insights.

The research findings underscored the critical importance of human oversight in the integration of AI in education, and recognised ChatGPT as a valuable tool for both educators and students. However, the study also identified three main risks: inherent biases in AI systems, the potential for GenAI to produce misleading or inaccurate information (referred to as 'hallucinations'), and privacy concerns. It is crucial that both students and teachers are aware of these risks. Regrettably, discussions about ChatGPT between students and teachers at CLD were found to be rare, indicating a lack of recognition of GenAI among teachers. Teachers cited time constraints as a significant barrier, resulting in limited attention being given to GenAI in their busy schedules.

Following this research, the ViP method was used to envision the future context of secondary education (Hekkert & van Dijk, 2011). This approach resulted in a framework consisting of the four different mindsets that teachers can have. Through semi-structured interviews with teachers of CLD, an alignment with one of these four mindsets was found. Teachers with this mindset are motivated and open to new methods if they improve their work or if they're beneficial for the students. This future context served as a guide for making decisions about the design direction of this project to incorporate the findings of the current context.

2. Research approach and methods
3. Current context
4. Future context
5. Design direction

02

Research approach and methods

Before starting the research phase, the project is given the domain of **secondary education in the Netherlands.** Research consisted of analysing the current context and future context of secondary education in the Netherlands. In this chapter, the research questions and methods used for the current and future context of secondary education will be discussed.

2.1. Current context approach
2.2. Future context approach
2.3. Conclusion

2.1. Current context approach

2.1.1. Research question

The overarching research question in understanding the current context was: ***What is the current context of secondary education and how is Generative AI being integrated into secondary education?***

To answer this research question, a combination of qualitative methods was used which are presented in the next sections.

2.1.2. Research Methods

1. Domain stakeholder interviews

Interviews with stakeholders in secondary education provided valuable insights into the current state of ChatGPT and its integration into educational practice. The identification of stakeholders in secondary education was carried out by SCO Delft. Based on their list of stakeholders, requests were made through social media platforms to interview them. Finally, interviews were conducted with key stakeholders in education, including educational publishers, Kennisnet, school boards and teachers who had already used ChatGPT in the classroom. Table 1 shows an overview of all stakeholders interviewed for this project. The interview guides can be found in Appendix A. The interviews were transcribed, coded and clustered which led to a comprehensive understanding of how education is currently adapting to GenAI and how it should integrate GenAI.

Stakeholder number	Profession	Employer
1	Head of AI at educational publisher	Thiememeulenhoff
2	Head of AI at educational publisher	Noordhoff
3	Technological Innovation team	Kennisnet
4	Chair of the school board	SCO Delft
5	Chair of the school board	Lucas Onderwijs
6	Secondary school teacher & employee NOLAI	NOLAI
7	Secondary school teacher & ChatGPT fan	Etty Hillesum Lyceum
8	Secondary school teacher & ChatGPT fan	Maerlant College Brielle
9	Professor Social sciences (Education)	University of Twente

Table 1: Overview of all domain stakeholders interviewed

2. Desk research

Desk research was conducted to gather information from reputable sources such as the Ministry of Education, Onderwijsraad, Kennisnet, NOLAI, the European Parliament and recent research papers. Search terms such as 'Generative AI', 'Generative AI education' and 'Generative AI secondary education' were used to identify relevant literature. Documents published after 2022 were selected to ensure alignment with the launch of ChatGPT in October 2022. In addition, preference was given to documents that addressed both GenAI and education, except for higher education.

3. Qualitative research on usage and view on ChatGPT with students and teachers

Research was conducted to understand the use and view of ChatGPT by teachers and students in secondary education. A user-centred approach was used by conducting semi-structured interviews (see research setup in Appendix D) with teachers. Teachers were recruited through a survey distributed throughout the school. Six teachers agreed to take part in this phase of the project, their characteristics can be found in Table 1. While all teachers expressed an interest in ChatGPT, there were different levels of use among them. This diversity allowed for a broader understanding of the teachers' different perspectives and attitudes towards ChatGPT.

Guerrilla interviews were conducted with students (see research setup in Appendix C). Students were invited to share their thoughts voluntarily to ensure their comfort and willingness to participate. Next to one-to-one interviews, a quick assessment of students' awareness and use of ChatGPT was conducted using a 'raise your hand if' approach. Three short questions were posed to the whole class and students were asked to raise their hands if they:

- Had heard of ChatGPT.
- Had used ChatGPT.
- Had used ChatGPT specifically for school purposes.

This approach provided an initial indication of students' familiarity and engagement with ChatGPT. The recruitment of students for the project was facilitated by the cooperation of one teacher at the school.

In total, seven students were interviewed and three classes were asked to raise their hands. All characteristics can be found in Table 2. The interviews were transcribed, coded and clustered which led to insights into the use, experiences and opinions of teachers and students.

Characteristics	# of teachers
ChatGPT experience	
Used ChatGPT every week	1
Has used ChatGPT 1-3 times	2
No ChatGPT experience	3
Subject they teach	
German	1
Biology	1
Science	2
English	1
Dutch	1
Gender	
Male	2
Female	4
Total number of participants	6

Table 2: Overview of teachers interviewed

Characteristics	# of students	# of classes
Grade		
Senior general secondary education	4	2
Pre-university education	3	1
Age		
16-17 years old	4	2
17-18 years old	3	1
Total	7	3

Table 3: Overview of students interviewed and amount of classes that were asked to raise their hands to answer questions

2.2. Future context approach

2.2.1. Research question

The overarching research question in understanding the future context was: ***What will the future of secondary education look like?*** The research methods used to answer this question are stated in the next section.

2.2.2. Research Method

1. ViP approach

To shape the future context, the Vision in Design (ViP) approach by Hekkert and van Dijk (2011) is used. This method can be used to look beyond the present and to design something for the unknown. This method starts by finding factors. Factors are developments, trends, states and principles and can be found in books, news articles, literary research, and interviews. In this project, factors were collected within the domain of secondary education. Different fields within the domain of secondary education were searched for factors. These fields are politics & democracy, finance & labour, economy, culture, psychology, ethics, demography, sociology, sustainability & ecology, technology and biology & evolution. Information within these fields that discussed secondary education was gathered and organised on whether they were a development, trend, state or principle. These factors were clustered. We call these clusters the 'driving forces' for the future context. At last, relations between these driving forces arose which led to a framework that consisted of the four different mindsets teachers can have.

2. Qualitative research into the mindset of teachers of CLD

Semi-structured interviews with teachers of CLD were done to gather insights into what teachers value in their work. The six teachers interviewed for the current context were also asked about their perspectives on teaching, providing valuable insights into their mindsets. Their characteristics are therefore shown in Table 2 on the previous page. The interviews were transcribed, coded and clustered which led the mindset of teachers at CLD.

2.3. Conclusion

This chapter outlines the different research methods used in the research phase of the project. The varying methods complement each other, offering insights into the current and future context of secondary education. These insights will be presented in the following chapters. Figure 3 gives an overview of the methods, outcomes and corresponding chapters.

Chapter	Research methods	Outcomes
Chapter 3: Current context	Domain stakeholder interviews	ChatGPT activity & level of control and implementation of AI in education
	Desk research	Risks and opportunities of AI
	Qualitative research with user group	ChatGPT usage and knowledge at Christelijk Lyceum Delft
Chapter 4: Future context	ViP method	The four different mindsets of teachers
	Qualitative research with user group	The mindset of teachers at Christelijk Lyceum Delft

Figure 3: Overview of research methods and outcomes per chapter

03

Current context

The main research question for the current context was: ***What is the current context of secondary education and how is Generative AI being integrated into secondary education?***

To answer this question, the previous chapter outlined all applied research methods. Data obtained from these methods were analysed, leading to insights into the current and future contexts of secondary education. This chapter discusses the insights concerning the current context. This includes the current activity regarding ChatGPT in education, the desired level of control and implementation of ChatGPT in education, and the risks and opportunities. Furthermore, findings into the view and usage of ChatGPT by teachers and students of CLD are discussed.

3.1. The current activity around ChatGPT in secondary education
3.2. Level of control and implementation of AI in education
3.3. Risk and opportunities of AI
3.4. ChatGPT usage and knowledge at CLD
3.5. Conclusion

3.1. The current activity around ChatGPT in secondary education

Through interviews with Lucas Onderwijs and SCO Delft, it was found that discussions about ChatGPT are actively taking place among school management (Interview, 2023). The primary focus of these discussions revolves around whether students should be permitted to utilise ChatGPT for their assignments or if it should be deemed as cheating. The hesitation among schools to fully embrace ChatGPT is largely due to the absence of national rules or guidelines governing its use. Many schools are awaiting guidance from the Ministry of Education, which formulates a programme with rules and guidelines for national education known as the Nationaal Programma Onderwijs (NPO), (Ministerie van Onderwijs, Cultuur en Wetenschap, 2023b). Secondary schools are anticipating the next iteration of NPO and intend to base their plans for implementing ChatGPT on this programme. In addiction, schools prefer to await the guidelines and vision of SLO (National Curriculum Expertise Centre) and the VO-raad (secondary school council), (Lucas Onderwijs, SCO Delft, Interview, 2023). SLO is responsible for the formulation of learning objectives and the VO-raad provides guidance on the implementation of them. Thus, while ChatGPT is already being utilised by many students and a small number of teachers (Quekel, 2023), the development of legislation regarding its use in schools will likely take some time before it is implemented.

At schools, a small number of discussions relate to how ChatGPT could be integrated into secondary education. For instance, Lucas Onderwijs is conducting small-scale “experiments” with ChatGPT at various secondary schools, executed by a small group of teachers already using the technology. These experiments explore the potential use of ChatGPT for tasks such as marking exams, a practice already adopted by a secondary school teacher in Hellevoetsluis (Maerlant College Brielle, interview, 2023). Another notable experiment involves two teachers at Dalton College who are developing a customised version of ChatGPT, specifically for their secondary school to ensure safe use by students. However, it’s important to note that these experiments are primarily driven by enthusiastic secondary school teachers’ initiatives and are not widespread across schools.

3.2. Level of control and implementation of AI in education

The ‘Onderwijsraad’ has conducted an investigation into intelligent technologies and has synthesised their educational recommendations into a report. (Ministerie van Onderwijs, Cultuur en Wetenschap, 2023). In this report, they refer to the model of Anne Horvers and Inge Molenaar (see Figure 4). This model revolves around the control between AI and the teacher (Schildkamp, 2023). In the ‘teacher assistance’ step (second step from the left), AI provides information to the teacher, and all control and monitoring for the implementation of that information remains the responsibility of the teacher. Meanwhile, in the ‘high automation’ step (fifth step from the left), various tasks are delegated to AI, and, as a result, control and monitoring are increasingly transferred as well.

The Onderwijsraad states that ‘partial automation’ (third step from the left) of education is desirable in certain cases. This means that technology should always be monitored by a human and will never take control. In addition, Kennisnet, an organisation dedicated to ensuring technology accessibility and utilisation in primary and secondary education, emphasised the importance of human oversight in order to monitor and control technology (Kennisnet, Interview, 2023).

The development of the AI act by the European Parliament also demonstrates the view that human involvement in decisions should always be present. Once AI started

“ChatGPT is just a tool, much like other tools in school. It’s simply a technological application that you can use alongside all your other technological tools to enrich your education.” - (Kennisnet, Interview, 2023)

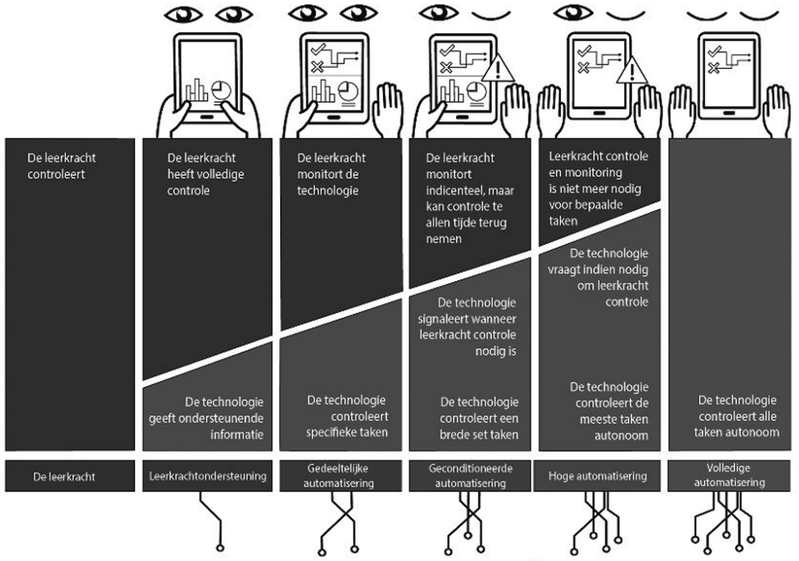


Figure 4: Model on the control of AI vs. teacher (Schildkamp, 2023)

growing, the European Parliament started developing the AI Act (European Parliament, 2020). When GenAI hit the market, they decided to speed up the legislation process. Therefore, the European Parliament have set up a draft law (2023). Figure 5 shows the section of the draft law that mentions education. The act states that it’s prohibited to use AI to detect emotions within an educational institution. Next to that, it’s stated that using AI to influence decisions regarding the admission of individuals and assessment of students comes with a very high risk. This suggests that AI should not be allowed to control important decisions that affect a student’s educational path. Throughout the interviews with domain stakeholders, the viewpoint in favour of partial automation was predominant, emphasising the importance of maintaining human control to ensure that oversight and decision-making authority remains intact.

In addition to the level of control of AI, domain stakeholders had strong opinions about the extent to which ChatGPT should be implemented in education. ChatGPT could be an assistant to the teacher or a study buddy for a student, but the teacher will always be in charge of ChatGPT (University of Twente, Interview, 2023). Kennisnet stated that you should never start with the goal that technology must be integrated into education. Start from

Figure 5: AI Act rules regarding education (European Parliament, 2023)

your school's vision of education and examine the challenges you encounter. Then see how technology can contribute to that (Kennisnet, Interview, 2023). Another framework that aligns with this view is the Smart Education Framework presented in Figure 6 (Demir, 2021). This framework states that intelligent technologies can effectively be used to achieve learning outcomes by using a pedagogical approach. The framework describes a strategy for schools to start with their education objectives and determine a suitable pedagogical approach. Then, schools decide what intelligent technology can be utilised to achieve their learning objectives. Once more, this demonstrates that in education, the primary objective should not be to integrate AI everywhere. Instead, it's important to pinpoint specific areas and moments where AI can truly enhance the established visions and goals within the vision and objectives of the school.

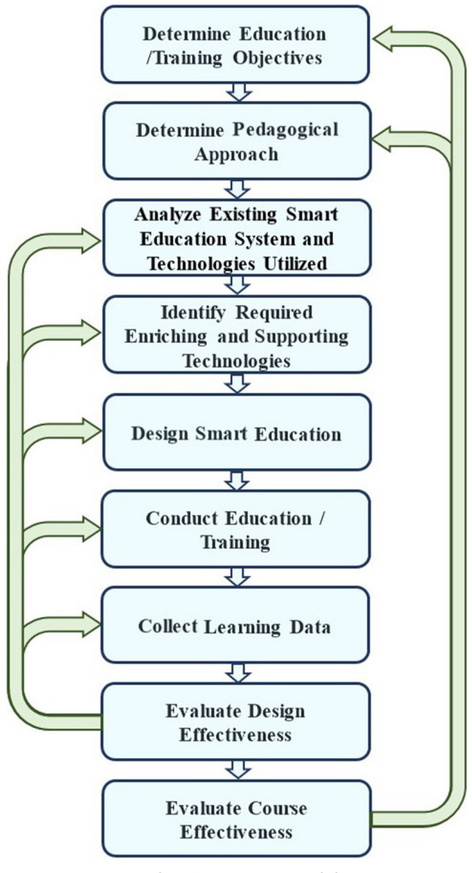


Figure 6: Smart Education Framework by Demir (2021)

3.3. Risk and opportunities of AI

Through research, both risks and opportunities associated with AI have been identified. Figure 7 provides an overview of these risks and opportunities.

Four potential opportunities of AI in education include the following: as a teacher's assistant, fostering creativity, enabling personalised learning, and acting as a study companion. It's crucial to note that these opportunities draw on research from other AI domains due to the scarcity of research on GenAI during the research phase. Given that GenAI is still an emerging field, it remains uncertain to what extent these opportunities will be realised in the field of GenAI in the future.

Conversely, five risks associated with AI have been identified. As shown in Figure 7, a lack of awareness of certain risks will lead to the emergence of new risks. Therefore, it's vital to tackle key risks to avert potential consequences. These key risks include bias in AI systems, privacy concerns and the potential for GenAI to generate misinformation (known as hallucinations).

Throughout the project, it became evident that both students and teachers were largely unaware of the significant risks associated with AI. Consequently, it was deemed necessary to raise awareness of these risks among educators and students before exploring the potential opportunities of AI. The following section will delve into these key risks. For a full understanding of the remaining risks and opportunities, please consult Appendix B.

3.3.1. AI has a bias

Humans naturally have biases, and as humans developed ChatGPT, it will inherit biases (European Parliament, 2020; Baidoo-Anu & Ansah, 2023). Next to that, the makers of a GenAI programme have control over what data the programme is trained on. This can also cause bias. It's considered crucial to make students and teachers aware of this (Council of Europe, n.d.).

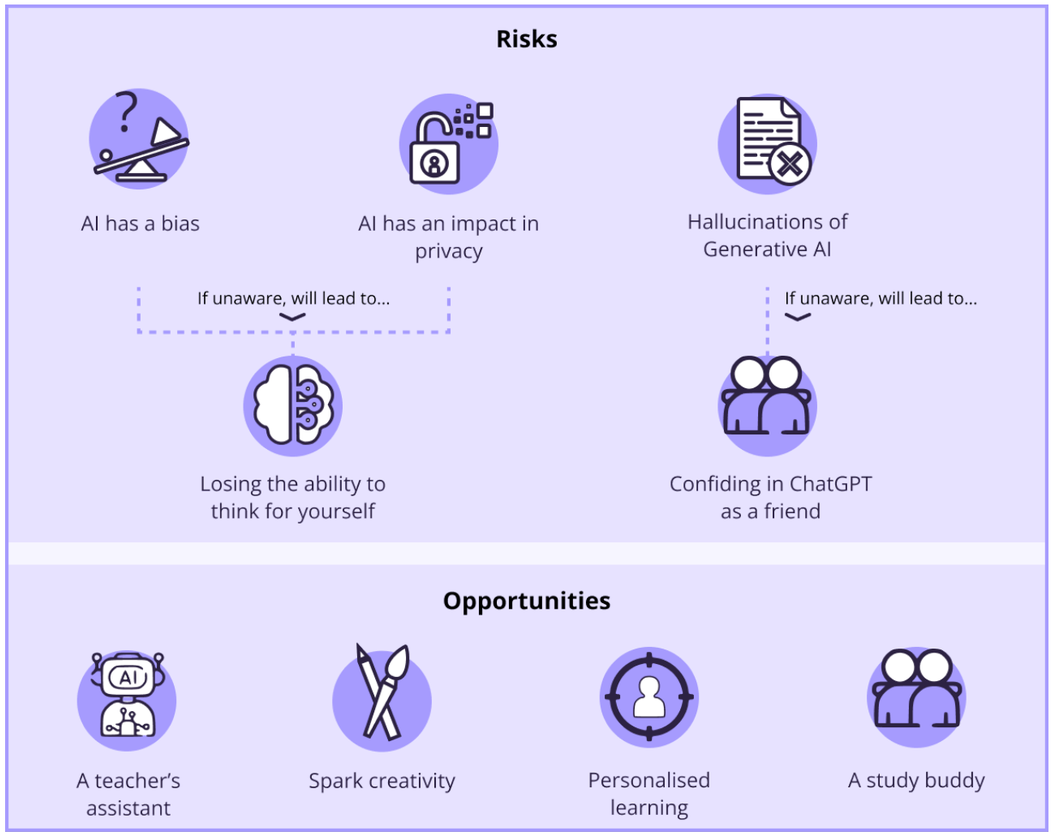


Figure 7: Risks and opportunities of AI

3.3.2. AI has an impact on privacy

ChatGPT uses the data of users included in prompts and questions to learn and improve (OpenAI, 2023). In April, OpenAI mentioned that users can now choose to share their chat history with OpenAI to be able to improve ChatGPT (see Figure 8). Before this, it took the data without asking. This makes people hesitant to use it, as they feel like it's invading their privacy (European Parliament, 2023). Both students and teachers should be aware of the impact ChatGPT has on their privacy.

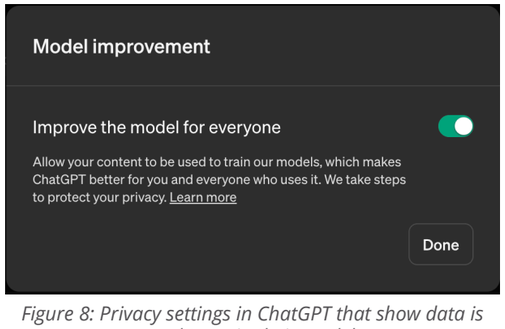


Figure 8: Privacy settings in ChatGPT that show data is used to train their models

3.3.3. Hallucinations of GenAI

ChatGPT is trained with a huge database. However, sometimes ChatGPT provides untrue answers. This is called a hallucination (Alkaissi & McFarlane, 2023). Next to that, the free version of ChatGPT has been trained on a large amount of data found on the internet up until January 2022 (OpenAI, 2023). Thus, the programme is not aware of any information after this January 2022. Therefore, students and teachers still need to have some sort of background knowledge of the topic they are working on to be able to criticize the output of ChatGPT.

3.4. ChatGPT usage and knowledge at CLD

To ensure that the previous research aligns with the specific context at CLD, interviews with students and teachers were done. The aim was to establish the current use and knowledge of ChatGPT by teachers and students. As outlined in Chapter 2, guerrilla interviews were carried out with students, while semi-structured interviews were conducted with teachers. This subchapter will delve into the view, usage and knowledge of students and teachers on ChatGPT.

3.4.1. ChatGPT usage and knowledge of students

ChatGPT knowledge

Inquiries into the functionalities of ChatGPT prompted diverse responses among students, who portrayed it as both artificial intelligence and a robot. Descriptions of ChatGPT's capabilities included its capacity to generate textual content and factual information. Moreover, ChatGPT was frequently likened to an "advanced version of Google." However, such comparisons suggest a misconception among students that ChatGPT works in the same way as Google. Additionally, comments were made stating ChatGPT was unbiased, while others claimed it was better than humans. This highlights the lack of knowledge among students regarding the nature of ChatGPT and the manner in which it generates its information.

"The questions I always used to ask Google, I now do with ChatGPT because I just get a much more concrete answer instead of having to search through eight websites before I get an answer" (Student 6)

ChatGPT usage

As shown in Figure 9, all students had heard of ChatGPT and 2/3 of students had used ChatGPT for school. Figure 10 shows that the majority of the students used ChatGPT to answer their questions, write texts for homework and translate foreign text to Dutch. In these cases, students replaced themselves with ChatGPT by letting it do their homework for them. In all use cases, the underlying motive was that the students either were too busy to do their homework or did not feel like working.

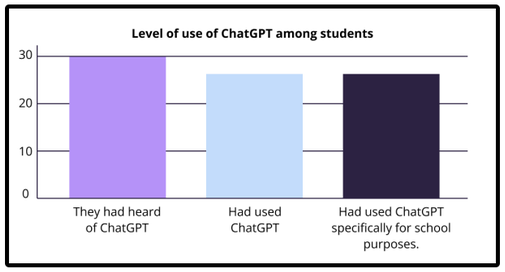


Figure 9: Results of raising hands

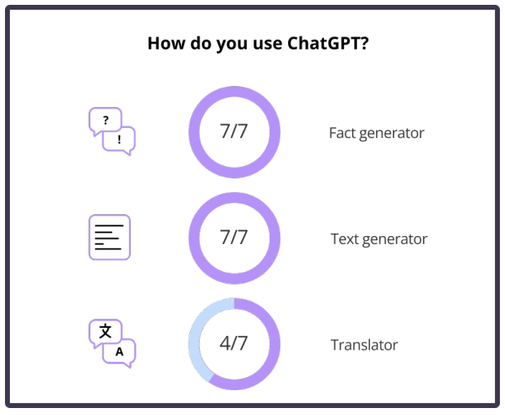


Figure 10: Use cases of ChatGPT among students

"If I have a week full of Dutch assignments and it gets a bit busy, then of course it's (ChatGPT) very useful to use it." (Student 3)

"You can just ask it anything and it will give you an answer. So that is very handy" (Student 1)

The appeal of ChatGPT for students is the speed, convenience and constant availability. Students perceive using ChatGPT for their homework as negative, because they instruct ChatGPT to complete entire assignments, resulting in them having no active involvement in the task. Nevertheless, they still often use it for this purpose. Next to that, students take extra safety measures to not get caught by teachers. As a conclusion, students are utilising ChatGPT for the wrong reasons.

"I'll still review it (ChatGPT), yes. It's safer since you're handing it in" (Student 5)

"I'll write it in my own words so that they can't see it with such a control, umm, chat." (Student 7)

ChatGPT through teachers

Most students noted that conversations about ChatGPT in the classroom were rare. When discussions about GenAI did occur, they were usually initiated by the same teacher who was enthusiastic about GenAI.

Therefore, it can be concluded that ChatGPT is not discussed often with students. This raises concerns as students don't have a full understanding of what ChatGPT is, how it works and where it gets its information. As a result, they may misuse ChatGPT for purposes other than its intended use, highlighting the need for education in this area.

3.4.2. ChatGPT usage and knowledge of teachers

Through interviews it was found that all participating teachers expressed an interest in GenAI, but had different attitudes towards ChatGPT. Their attitudes and views will be discussed in this section.

ChatGPT usage

As Figure 11 shows, one out of six teachers frequently used ChatGPT. Two teachers had played with ChatGPT a little bit (2-3 times) and three knew of ChatGPT but never used it themselves. Through the interviews, it was found that all six teachers expressed an interest in GenAI, but have different attitudes towards ChatGPT. These three attitudes towards ChatGPT were: the overwhelmed teacher, the underwhelmed teacher and the enthusiastic teacher.

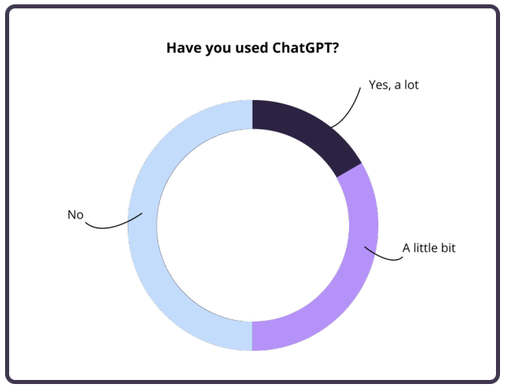
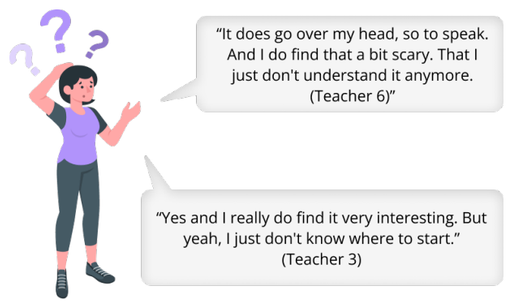


Figure 11: Usage of ChatGPT

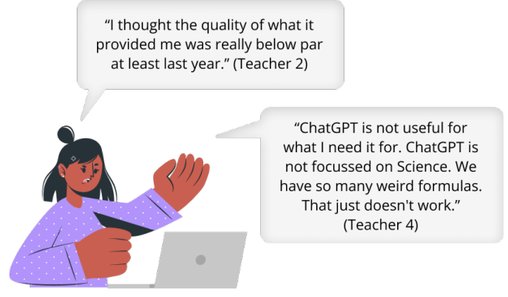
The overwhelmed teacher

For those teachers who didn't use ChatGPT, the reason was that they felt overwhelmed by it. They didn't know where to start, or found it frightening that they didn't understand how ChatGPT could generate content. Nevertheless, these teachers did mention being interested in using it, but just didn't know how to.



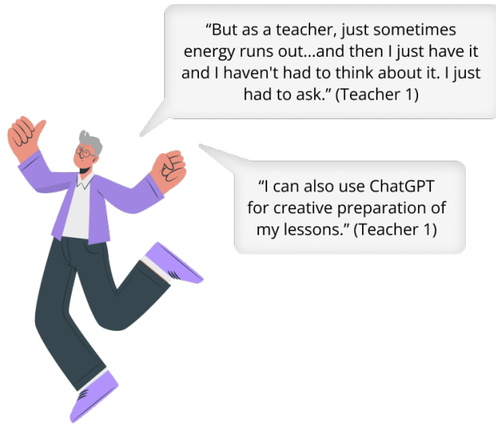
The underwhelmed teacher

Two teachers who had tried ChatGPT, mentioned that they had not found it to be of much use to them, so they did not continue with it. They mentioned that the quality of the results was not good or that ChatGPT did not work well with the course they were giving. They are open to using GenAI for their work, but are waiting for GenAI programmes that work better for the subject they teach.



The enthusiastic teacher & AI inspiration group

The one teacher who frequently used ChatGPT expressed enthusiasm and mentioned that while ChatGPT doesn't work perfectly it helps him a lot in his work. He likes to use it when he needs inspiration for materials for their lessons, or when he needs to write something but his energy is low. This teacher is also part of the 'AI inspiration group' of the school. Teachers can join this group voluntarily. Currently, the group consists of seven teachers. They have gotten together once to discuss how they could implement AI at school. Since then, not a lot has happened with this group. Nevertheless, it shows that a small number of teachers are interested in GenAI.



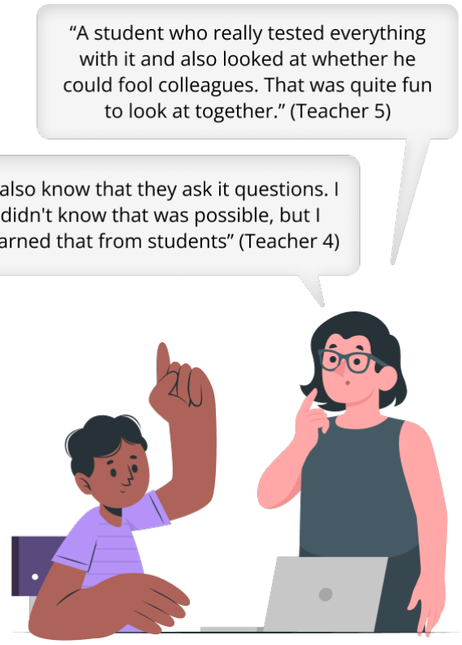
ChatGPT through students

As of now, most teachers come into contact with ChatGPT through their students. In most cases, this is a negative interaction, witnessing a student's misuse of ChatGPT. Therefore, the connection with ChatGPT becomes negative for teachers.

"But when you're talking about what you don't actually want to spend time on, it would be acting as a detective to determine whether your students are committing fraud." (Teacher 2)

Nevertheless, some teachers also experienced positive interactions with ChatGPT through their students. This happened when students openly showed and presented how they had used ChatGPT.

This way, the teachers learned new things about GenAI through their students.



View on ChatGPT

Although most teachers seldom used ChatGPT themselves, most teachers expressed strong opinions about the tool. Some compared ChatGPT to a parrot, implying that it merely regurgitates text from its database. However, it's important to understand that ChatGPT is a GenAI programme, meaning that it doesn't just copy and paste text. This highlights a gap in teachers' understanding of how ChatGPT generates content. Additionally, teachers emphasised the importance of students being critical of the content generated by ChatGPT. Finally, teachers did not necessarily view ChatGPT as bad for students, provided that students are educated in its proper use (i.e., not relying on it solely for completing homework assignments).

3.5. Conclusion

The goal of this chapter was to gain an understanding of the current context of secondary education and how secondary education is adapting and utilising ChatGPT. To answer this research question, research was conducted in the current context of secondary education. Next to that, qualitative interviews with teachers and students at CLD were conducted.

Research in the current context showed that there is a general consensus that human oversight is crucial whenever AI is employed in education. The envisioned role for ChatGPT in education is that of a supportive tool that can benefit both teachers and students. Next to that, three key risks were discovered. These risks include the biases inherent in AI, the ability of GenAI to hallucinate, and the privacy implications associated with its use.

Research conducted at CLD has shown that students often use ChatGPT for inappropriate purposes, such as completing school assignments, without a full understanding of the nature of ChatGPT and its information-gathering process. This raises concerns about whether students are aware of the aforementioned risks associated with the use of GenAI. Discussions about ChatGPT are rare in the classroom, suggesting that teachers are not adequately addressing the topic. Furthermore, teachers at CLD rarely use ChatGPT themselves, due to limited time to explore new topics such as GenAI. This leads to students not being shown how to critically use ChatGPT and instead use it for the wrong reasons.

In conclusion, teachers need to educate themselves about GenAI and gain experience with ChatGPT to effectively guide students in its responsible use. In the next chapter, the ViP method is used to form a framework for the four different mindsets teachers can have. These mindsets are then compared to the teachers of CLD. Finally, based on the findings of the current and future context, a problem statement and design direction are formulated.

04

Future context

In the previous chapter, the current context was analysed. Having gained insights into the current context, this chapter dives into the future context of secondary education in 2030. The main research question for this chapter is: ***What will the future of secondary education look like?***

Chapter 2 highlighted the use of the ViP method to address the research question at hand. This method begins with the identification of various factors, including developments, trends, conditions and principles, which are drawn from literature, news sources, academic research and interviews. As detailed in Chapter 2, an extensive exploration across multiple fields was undertaken to identify factors relevant to secondary education. These were then organised into clusters referred to as the 'driving forces' for the future context.

This chapter provides a discussion of the twelve driving forces shaping the future context of secondary education. These driving forces have been instrumental in shaping a framework that delineates the four distinct mindsets observed among educators. A comparison is then made between these mindsets and those prevalent among teachers in CLD, assessing potential overlap.

4.1. The driving forces for the future of secondary education
4.2. Framework: The different mindsets of teachers
4.3. The mindset of teachers at CLD
4.4. Choosing a mindset
4.5. Conclusion

4.1. The driving forces for the future of secondary education

One hundred ten factors were found in the fields of politics & democracy, finance & labour, economy, culture, psychology, ethics, demographic, sociology, sustainability & ecology, technology and biology & evolutionary. This ensured the creation of a holistic perspective on the domain. In this project, 12 driving forces have been found for the future of secondary education. As mentioned before, the driving forces are related to each other and together form a framework for the future context. The factors that have shaped these clusters can be found in Appendix E. In the next sections, the driving forces will be discussed.

1. Adapting to the digital generation

Research showed that Generation I has embraced digital technology as an essential part of their lives today (Jain, 2013). Subsequent generations have continued to adopt this as well (Piersma & Wiggers, 2023). A good example of this technological integration can be seen in the fact that young people sometimes share passwords as a sign of affection (KNAW, 2013).

This integration has influenced Generation Alphas to have a speed of browsing, a need for short answers and immediate feedback. Next to that, they have a preference for multitasking behaviour. However, these form obstacles in the development of critical thinking, which takes time and attention or interest in details (Drugaş, 2022).

Education is trying to adapt to the digital lifestyle of students by integrating approaches like game-based learning (Darwesh, 2016). While game-based learning in education is not a recent development, it's experiencing a significant surge in popularity due to students' online engagement (Neendoor, 2023).

2. The negative influence of technology on schoolwork

Secondary school students are faced with a lot of school and homework. A report by Nederlands Jeugdinstituut showed that this is also the biggest driver of stress for students and that the number of students in secondary education who experience pressure due to schoolwork has increased significantly (Nederlands Jeugdinstituut, 2023).

Next, the relationship between poor mental health correlates negatively with upper secondary school completion and grades (Brännlund et al., 2017; Van Den Eijnden et al., 2019). This creates a cycle where schoolwork causes stress and influences their mental health, but this again influences their schoolwork. Another factor that can now be added to this cycle, is the use of their phone. The report by the Nederlands Jeugdinstituut found that 39% of secondary education students say they spend less time on homework and schoolwork due to smartphone usage. Also, compulsive social media use negatively impacts young people (11-18 years old), leading to poorer academic performance and concentration issues (Cavdar, 2023).

3. The rise of ChatGPT is making education more dynamic

Due to the increasing popularity of ChatGPT among students, several schools are experimenting with alternative student assessments (Samplonius, 2022; Schildkamp, 2023). This is mainly driven by the necessity to develop new assessment approaches that prevent students from relying on ChatGPT to complete assessments on their behalf (Noordhoff, Interview, 2023). While the reason might be perceived as negative, ChatGPT is causing a dynamic shift in education where teachers have to revisit their static way of educating. The smart education framework, which is mentioned earlier in this document, is a great example of how intelligent technologies enable education to become more dynamic (Demir, 2021).

4. The power of AI-enabled personalised online education

Multiple studies suggest that the learning process differs based on the individual learner (Janati et al., 2018). Nevertheless, most educational institutions offer a standardized pace and toolset for each student (Mead, n.d.). Adapting the content and experience to individual learners often results in better user retention and a more meaningful and deeper learning experience (Chiotaki et al., 2023). A good demonstration is the fact that children learn words more easily when they are interested in the category to which the word belongs (Ackermann et al., 2019).

Due to COVID-19, education was forced to become more digitalised (Onderzoek Naar Corona En Onderwijs, 2023). This revealed that online education provides more flexibility for students and forces them to learn more independently (Cursum, 2022; Academy_Admin, 2023). Therefore, online education gained more popularity (Schildkamp, 2023). This resulted in multiple collaborations between companies and education institutions to create platforms that allow students to work at their own pace (Snappet Nederland B.V., 2023; Gynzy, n.d.). Central to this change is AI as the driving force that makes it possible to provide personalized AI-driven tutoring and feedback to students based on their individual learning needs and progress (Baidoo-Anu & Ansah, 2023).

5. The opinion of the teacher matters

While AI might make education more personalised by providing AI tutors, teacher support is still seen as an important pillar when setting and striving for goals for students (Van Kammen, 2022). Several studies have shown that students value the feedback of the teacher. As an example, children whose teachers have low expectations tend to experience a less stimulating learning environment compared to children whose teachers have high expectations. In addition, receiving compliments from the teacher has a positive effect on the self-confidence of students (Smeets et al., 2022).

6. The classroom as an important driver for social contact

While digitalization and online education are becoming more popular, it's important to maintain physical education as well. Social contact between students and teachers is crucial for both parties involved. During adolescence, social relationships, including whether you 'fit in' and how others perceive you, play a significant role in the development of a sense of uniqueness. This sense of uniqueness is achieved through contact with peers and teachers (Sollie et al., 2023). In addition, research has shown that social interaction in the physical environment has a positive impact on students' learning and social interaction (Sherzod & Leonodovna, 2023; Nahardiya et al., 2022).

Besides that, a good relationship between students and teachers is crucial (Nederlands Jeugdinstituut, 2022c) and both students and teachers profit from it (Koomen, 2013). Students get more motivated and teachers have better wellbeing (Van Der Want, 2015). Moreover, the Self-Determination Theory (SDT) explains that one of the three key psychological needs that drive motivation is relatedness (University of Rochester Medical Center, n.d.). This signifies the human desire for connection with others. This theory is widely applied across various domains including education.

7. Good mental health is fundamental for a good relationship with AI

In the interaction with AI, teachers' self-confidence plays a crucial role in building a good relationship with AI. Personal characteristics are associated with one's satisfaction and engagement with AI

(Timotheou et al., 2022). An example of this is that humans often misattribute blame to themselves when technology performs poorly (Chong et al., 2022). Additionally, there exists an interdependent relationship between stress and the satisfaction of technology use (Liang & Lee, 2017). This shows that mental health is important to be able to confidently interact with AI.

8. Fear of the unknown in AI

Certainty is an important factor in being able to trust someone or something (Godbole, 2017) and to ensure that people start using AI trust is needed (Lorenz, n.d.). So, to be able to trust AI, transparency is required (Floridi, 2016; Floridi and Taddeo, 2016; European Parliamentary Research Service, 2022).

In many cases, users are left uncertain about the reasons behind ChatGPT's behaviour, sometimes even perplexing its creators ("ChatGPT Is a Black Box: How AI Research Can Break It Open," 2023). Consequently, the lack of transparency fosters a sense of doubt towards GenAI.

9. We like the way things are

Humans have a tendency to resist change and the reason for this is that we are creatures of habit (Zimmerman, 2006). Furthermore, individuals generally struggle to recognise the need for change (Greenberg & Baron, 2017). This resistance to change extends to teachers' attitudes towards GenAI, with many perceiving it as merely a passing trend and maintaining their confidence in traditional teaching methods (Maerlant College Brielle, interview, 2023).

10. The pressure to perform keeps building

Teachers experience high pressure at work. In 2023, a school survey revealed that 45% of teachers fear that the results of their students are not good enough, with 42% fearing a burnout (Teacher Tapp, 2023). Despite knowing the workload challenges before accepting a job as a teacher, many teachers still acknowledge it as their primary cause for leaving the work field (Perryman & Calvert, 2019).

The World Economic Forum organises an annual gathering of intellectuals, journalists, CEOs from the world's largest companies and international politicians. Each year, they release a Future Jobs Report. This year's reports suggest that 23% of jobs will be distorted (World Economic Forum, 2023). Next to that, a report of Ministerie van Onderwijs, Cultuur en Wetenschap states that in 2030, almost 6% fewer full-time teachers will be needed than in 2020 (2022). As a result, AI is causing a fear of unemployment, amplifying the work pressure of teachers (Liang & Lee, 2017; Gherheș, 2018).

11. A need for tech-savvy teachers but no supply

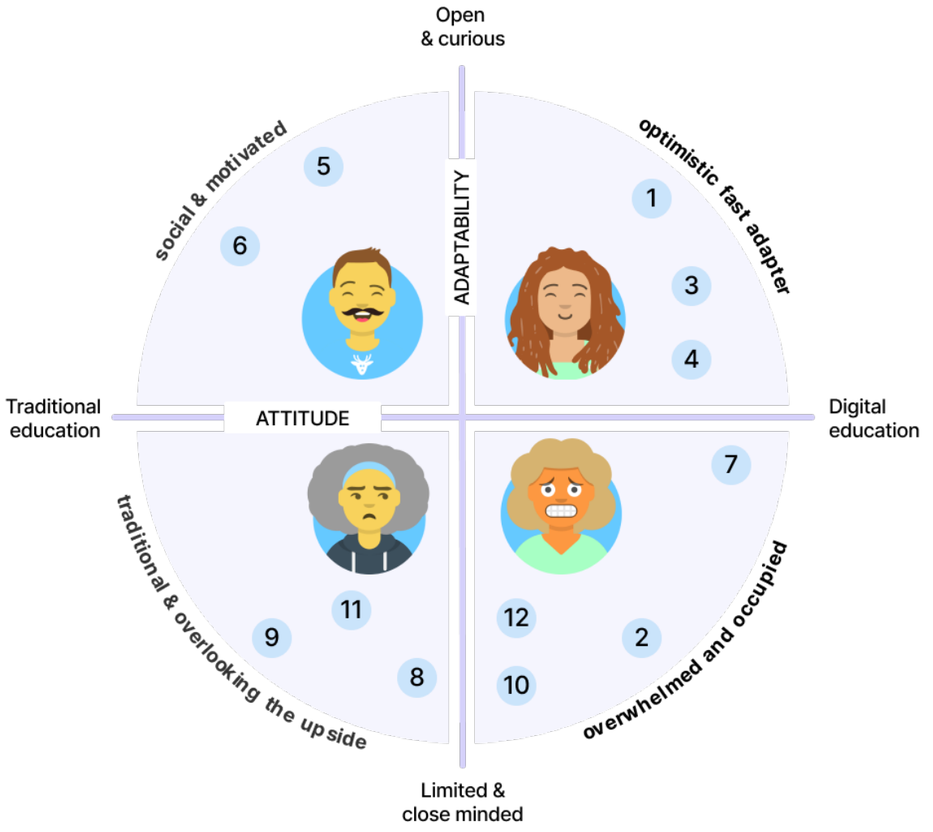
Digital literacy has gained a place in secondary school education due to a push for digitalization (European Commission, 2020; AG Connect, 2022). Yet, meeting this demand requires tech-savvy teachers (Piersma & Wiggers, 2023). Unfortunately, there is a shortage of teachers, particularly for the critical subject 'Informatica' which is utilized to teach digital literacy (VO raad, 2023).

12. Adopting digital skills requires effort and time

Teachers' lack of ICT skills and familiarization with technologies can become a constraint to the effective use of technology in the classroom. Therefore, it's crucial to train teachers to use computers as a teaching and learning tool (Timotheou et al., 2022). Nevertheless, users need to put in considerable effort to make a digital tool work, adding to the workload of teachers. (Piersma & Wiggers, 2023). Next to that, teachers' busy schedules prevent them from acquiring new digital skills, creating a barrier to the adoption of digitalization in education (Maerlant College Brielle, University of Twente, Interviews, 2023).

4.2. Framework: The different mindsets of teachers

When looking for relationships between the driving forces, opposing forces appeared. Based on these opposing forces, a two-dimensional framework was created, which is shown in Figure 12. The horizontal axis represents people's attitudes towards education, ranging from traditional to digital education. The vertical axis represents people's level of adaptability, ranging from limited & close-minded to open & curious. Within this framework, four mindsets appeared. These mindsets encapsulate the different attitudes that teachers may adopt as they navigate the future of secondary education intertwined with AI. The following page will discuss these mindsets.



1. Adapting to the digital generation
2. The negative influence of technology on schoolwork
3. Making education more dynamic through the use of AI
4. The power of AI-enabled personalised online education
5. The opinion of the teacher matters
6. The classroom as an important driver for social contact
7. Good mental health is fundamental for a good relationship with AI
8. Fear of the unknown in AI
9. We like the way things are
10. The pressure to perform keeps building
11. A need for tech-savvy teachers but no supply
12. Adopting digital skills requires effort and time

Figure 12: The four mindsets of teachers

4.2.1. Traditional & overlooking the upside

Driving forces 8, 9 and 11

A teacher who obtains this mindset has years of teaching experience. They prefer their familiar methods and tools they trust to use and cannot see the upside of AI as they have never used it before and are not planning to. They dislike AI and mostly see it as a threat.

4.2.2. Overwhelmed and occupied

Driving forces 2, 7, 10 and 12

As mentioned in driving force 10, teachers experience high pressure at work. A teacher who falls into this mindset is already struggling to keep up with their busy work schedule and does not feel like there is space to look into new developments like AI.

4.2.3. Optimistic, fast adapter

Driving forces 1, 3, and 4

These teachers are in general optimistic and curious when it comes to new developments. They like to try out new things and can easily adapt to new developments. They do not see the dangers that AI could have.

4.2.4. Social & motivated

Driving forces 5 and 6

This teacher finds joy in positive relationships with students and wants to improve their work for the sake of their students as they are the fuel to their motivation. Teachers in this category are open to change but do not immediately feel drawn to digital developments. Nevertheless, they like to improve their methods. Furthermore, if something is seen as beneficial to students, they often show a willingness to adopt it.

4.3. The mindset of teachers at CLD

To ensure that at least one of the mindsets found in the previous research aligns with the specific context at CLD, interviews with teachers were done. The same teachers that were interviewed about ChatGPT, were also asked questions about their work. Teachers were asked about all the tasks that they have to do in their work. These tasks were written down on task cards. Following up to this, teachers had to place these tasks onto a value sheet (see Figure 13).

Afterwards, the teachers were asked to explain why they value certain tasks more than others. This helped determine what the teachers value in their work. During the interviews, the importance of the tasks themselves, the significance of students, and the value of colleagues emerged. These findings revealed that teachers of CLD value positive social interaction with pupils and the opportunity to improve their work. An overview of these findings is visualised in Figure 14.

A comparison of the perspectives of the teachers at CLD with the four mindsets outlined in the framework reveals a clear alignment with the fourth mindset, namely the social and motivated mindset. Subsequent sections will present the mindset of the teachers of CLD.

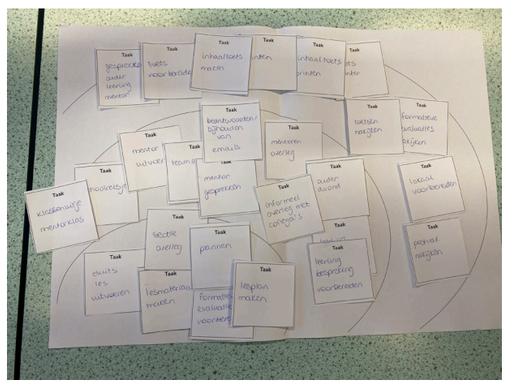


Figure 13: Value sheet of one of the teachers

Figure 14: Visualisation of the findings on the mindset of teachers at CLD

4.3.1. Ability to improve work

At CLD, teachers are known for being innovative, dynamic, and energetic. They love having the freedom to experiment and try out fresh ideas in their classes. Teachers have strong opinions about what is good and poor quality teaching and therefore critically evaluate new course materials and lesson plans. Next to creating, they value any task that enables them to improve their teaching abilities. Therefore, they appreciate being able to easily test their ideas in the classroom, which provides them with a fast feedback loop. Any task related to their subject and enhancing their teaching abilities serves as motivation for their job. Next to that, they like to work fast and effectively. As well as creating new materials, teachers like the immediate feedback loop in education. This immediate feedback is provided by students' responses in the classroom. This rapid feedback loop is invaluable to them in refining their teaching methods and improving student learning outcomes.

4.3.2. Time is scarce

In addition to teaching and making teaching materials, teachers at CLD have many other tasks that take up their time. Due to the number of tasks throughout the year, time is scarce for teachers and they have to divide their time wisely. Some teachers struggle to find a balance between these competing tasks, while others have adopted a strict planning approach to avoid feeling overwhelmed. But, even the teachers who have tightly scheduled timetables often find themselves short on time to accomplish everything they aim to do within a week.

4.3.3. A connection with students

Next to creating and improving teaching materials, they place significant value on fostering connections with students and contributing to their personal development. This connection remains an ongoing driver in their profession and serves as a motivational factor.

4.4. Choosing a mindset

Designing for the various mindsets teachers can obtain towards GenAI in education poses a complex challenge, as different mindsets necessitate different approaches. Furthermore, there will always be teachers who are reluctant to embrace or incorporate GenAI, similar to those who still prefer traditional pen and paper methods to digital tools. Therefore, it was decided to focus on designing for one of the four mindsets of the framework.

When comparing the perspectives of the teachers at CLD with the four mindsets outlined in the framework, there is a clear alignment with the fourth mindset: the social & motivated mindset. Teachers with this mindset are motivated and open to new approaches if these approaches improve their work or if they benefit the students. Therefore, it was decided to design for teachers with this mindset. This provides an opportunity to tailor the design to the needs and preferences of teachers who have this mindset, potentially attracting their interest and engagement. However, it's important to recognise a significant constraint: teachers face demanding schedules and have limited time to engage with new topics such as GenAI. This limitation must be taken into account when designing interventions or educational materials aimed at this audience.

4.5. Conclusion

The aim of this chapter was to envision the future context of secondary education in 2030. Using the ViP method, a framework was developed that identifies four mindsets that are prevalent among teachers. These mindsets encapsulate the different attitudes that teachers may adopt as they navigate a future landscape of secondary education intertwined with AI.

As designing for the various mindsets teachers may have towards GenAI poses a complex challenge, it was decided to focus on one of the four mindsets of the framework. It was found that the fourth mindset of the framework aligned best with the mindset of teachers of CLD. Consequently, the final design of the project will be tailored to teachers with a social and motivated mindset. However, it's important to recognise a significant constraint: teachers face demanding schedules and have limited time to devote to new topics such as GenAI.

With these considerations in mind, the following chapter proposes a problem statement and design direction that are informed by insights from both the current and future contexts of secondary education.

05

Design direction

In the previous chapter, a framework was established to describe four different mindsets secondary school teachers can adopt towards GenAI in education. Following a comparison with the mindset of teachers of CLD, it was determined that designing for teachers with a social and motivational mindset would be most appropriate. In this chapter, insights from both the current and future contexts are used to shape our problem statement and design direction. In addition, the criteria for guiding the design direction are discussed.

5.1. Problem statement
5.2. Design direction
5.3. Conclusion

5.1. Problem statement

Findings from the research phase showed that students frequently use ChatGPT for schoolwork, but are often unaware of the risks involved. It's crucial for teachers to guide students in the responsible use of ChatGPT and to educate them about these risks. However, ChatGPT is rarely discussed in class, suggesting that teachers do not consider it important. In addition, teachers at CLD rarely use ChatGPT, mainly due to limited time to explore new topics such as GenAI. This results in students not being taught how to use it critically.

The problem statement therefore states:

"Teachers need to develop knowledge and experience of GenAI in order to educate their students about it in the classroom. Currently, this is not being done due to their demanding schedules and unclear guidance from their management, resulting in students not being shown how to critically use GenAI".

5.2. Design direction

It was decided to focus on teachers with a social and motivated mindset. Teachers with this mindset are open to new approaches if they improve their work or benefit their students. Leveraging this mindset and addressing the problem statement, a design statement is proposed:

"In a world undergoing digitalisation, I want teachers to engage in social interaction **with students while acquiring** Generative AI knowledge and experience**."**

5.1.1. Social interaction

As social and motivated teachers place value in the connection with students, the final design has to include social interaction with students to stimulate teachers to use it. This approach allows both teachers and students to collectively build a foundational understanding of GenAI and explore its applications together.

5.1.2. GenAI knowledge

As mentioned in Chapter 3, it was found that students lack knowledge about how ChatGPT works and what information it uses to generate content. They also lack awareness of the risks involved in using GenAI. The main risks that students need to be aware of are:

1. GenAI contains biases
2. GenAI hallucinates
3. GenAI has an impact on privacy

It's crucial that students are aware of these risks. Therefore, teachers should also be aware of these risks and be able to explain to students why these risks exist in the first place. Therefore, both students and teachers need to acquire GenAI knowledge. It's important to note that the aim is not to scare students away from using ChatGPT, but simply to make them aware of these risks so that they can make their own decisions about whether to use it.

5.1.3. GenAI experience

As found in Chapter 3, students' use of ChatGPT has mainly been for one purpose: asking questions and doing homework. However, there are other ways in which GenAI could be used for school or personal work, such as a writing assistant or digital tutor (Skrabut, 2023). The interviews revealed that teachers have strong opinions about how students should use ChatGPT, but only a small proportion of teachers actually use ChatGPT themselves. Teachers should be able to guide students in the use of ChatGPT and therefore have experience of using it themselves.

In addition, active learning improves the academic achievement of individuals (Yannier et al., 2021; Özgür, 2023). Active learning is an approach to teaching in which students are actively involved in the learning process, rather than passively receiving information from the teacher. It involves students taking part in activities such as experiments or discussions. Therefore, it's important for both teachers and students to gain experience with GenAI by actively using it.

5.1.4. Criteria

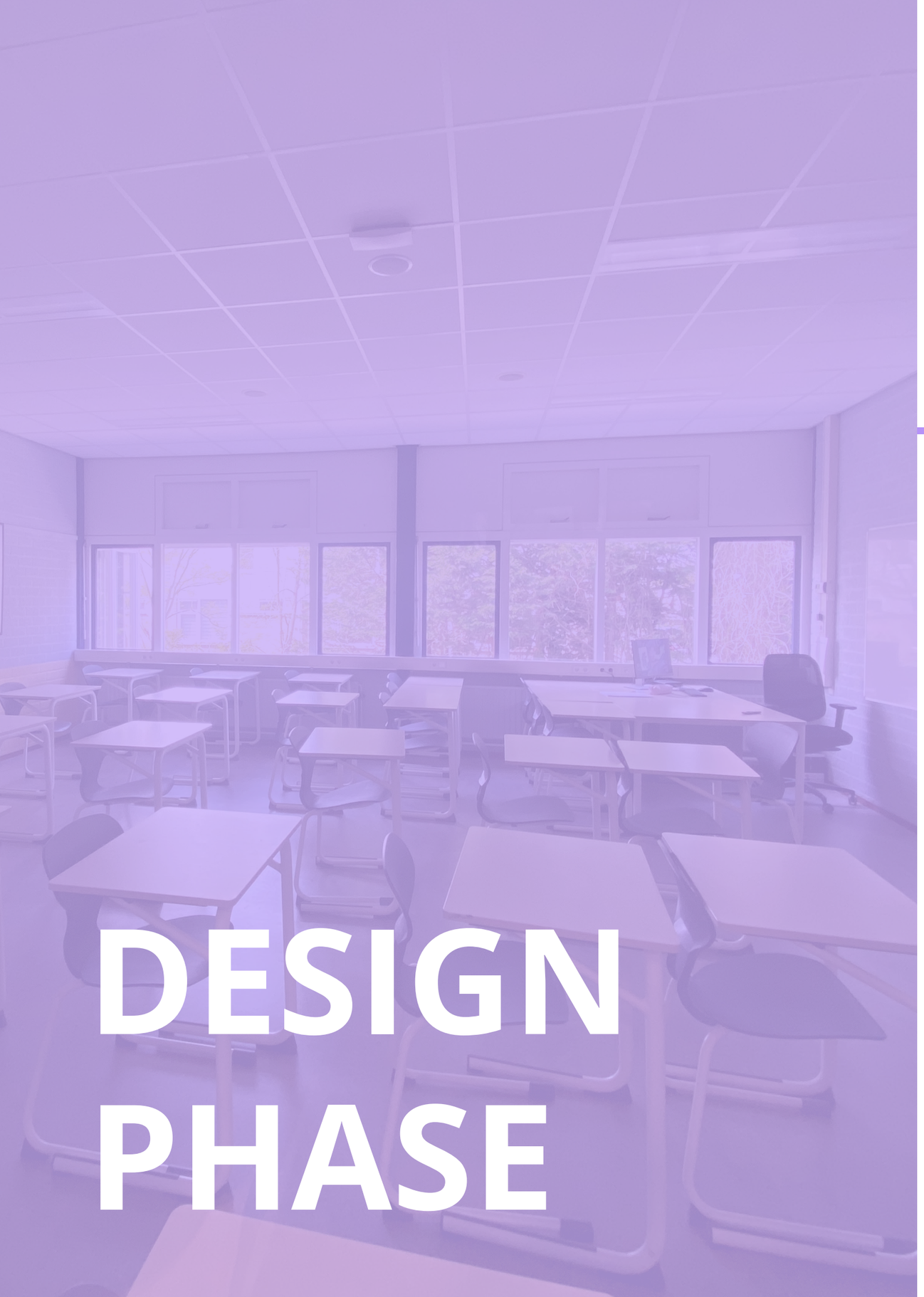
Drawing from the research and discussions with CLD, the final design should fulfil the following criteria to ensure usability of it for teachers:

- As time is limited for teachers the final design should occur during class time. This is 50 minutes.
- As time is limited for teachers, the final design should require minimal preparation time.
- The final design should be able to stand on its own, without the external assistance of the designer. This means the concept should be doable by teachers that lack GenAI knowledge and experience.

5.3. Conclusion

The aim of this chapter was to establish a design direction for the project. In order to formulate a design statement, a problem statement was developed: "Teachers need to develop knowledge and experience of GenAI in order to educate their students about it in the classroom. Currently, this is not being done due to their demanding schedules and unclear guidance from their management, resulting in students not being shown how to critically use GenAI"

Based on this problem statement and the identified teacher mindset, a design direction emerged. This design direction emphasises the importance of fostering social interaction between teachers and students while integrating GenAI into educational practice. As a result, it has the potential to stimulate the interest and engagement of teachers who are receptive to exploring innovative methods that enhance their work or benefits their students. The outcomes of this chapter form the base for the design phase.



DESIGN PHASE

Facilitating the integration of GenAI into secondary education

Following the research phase, this phase focuses on the design process. The design phase was kicked off with multiple brainstorming sessions to generate ideas. Individual brainstorms were done by the designer and two creative sessions were held with multiple design master students. These brainstorms resulted in the desired qualities for the final design of the project.

A design-through-doing approach was used to develop concepts. In this approach, concept prototypes are taken to the context and stakeholders early on in the process and are immediately tested (Rincón-Saavedra et al., 2019). This allowed for quick iterations of the concept and the exploration of alternative directions if necessary. This resulted in two successful and functional prototypes: a lesson module and a website.

In order to provide guidance for the integration of GenAI in secondary education over the next two years, a roadmap has been developed following the framework outlined in Simonse's guidebook (2017). Through the use of the website and lesson module, this roadmap lays the groundwork for the integration of GenAI beyond the parameters of our project.

6. Design methods
7. Desired concept qualities
8. The concepts & concept testing
9. Implementation
10. Conclusion

06

Design methods

Following the problem statement and design direction established in the research phase, this chapter focuses on the different design methods used to develop the concepts. The results of these methods are presented in the following chapters.

6.1. Individual brainstorms and creative sessions
6.2. Design-through-doing
6.3. User involvement
6.4. Conclusion

6.1. Individual brainstorms and creative sessions

For the first phase of ideation, individual brainstorms and creative sessions helped identify the desired concept qualities for the final design of the project. Two creative sessions were done with two small groups of Industrial Design Engineering students. Design students were selected because of their ability to easily articulate their creative ideas and rationale for proposed actions. Their familiarity with design principles and processes made them well-suited to contribute meaningfully to the discussions and activities conducted during these sessions. For these creative sessions, creative problem solving techniques were used formulated by Heijne and van der Meer (2019). Their techniques allow people to be creative which leads to novel and useful solutions. In Appendix F, a full setup for the creative sessions can be found. Figure 15 shows the two creative sessions in action.

Figure 15: Top image is Creative Session 1, Bottom image is Creative Session 2

6.2. Design-through -doing

Through a design-through-doing approach, concept prototypes were tested early in the process to allow for quick iterations of the concepts or the exploration of alternative directions (Rincón-Saavedra et al., 2019). All tests with prototypes of the concepts were done at CLD with various secondary school teachers and their respective classes. Teachers and their classes were recruited through surveys and email correspondence. In total, eight different teachers tested different versions of concept prototypes throughout this project. Table 4 gives an overview of all tests done during this phase of the project.

As ChatGPT is blocked on the school wifi, an alternative GenAI programme was needed. Consequently, Copilot was used during the testing phase of all concepts. Copilot uses the same large language model as ChatGPT, so users get similar responses. Copilot also has a similar interface to ChatGPT (see Figure 16). In addition, Copilot is free and has Internet access (Bing), which makes it more reliable than the free version of ChatGPT. Furthermore, Copilot can generate not only text, but also images and sounds. Therefore, it was considered appropriate to introduce this programme to teachers and students.

Version of concept	Class	Teacher
Concept 1.1	HAVO4	Computing Science
Concept 1.2	HAVO4	Computing Science
Concept 2.1 Exercises: Fake facts Self-portrait	VWO3	English
Concept 2.2 Exercises: Future scenario Brainstorm	HAVO5	Science
Concept 2.3 Exercise: Extension brainstorm with prompting	HAVO5	Biology
Concept 2.4 Exercise: Dependent on information	VWO2	German
Concept 2.5 Exercise: Comparing programs	VWO5	Science

Table 4: Overview of tests with concept prototypes at CLD

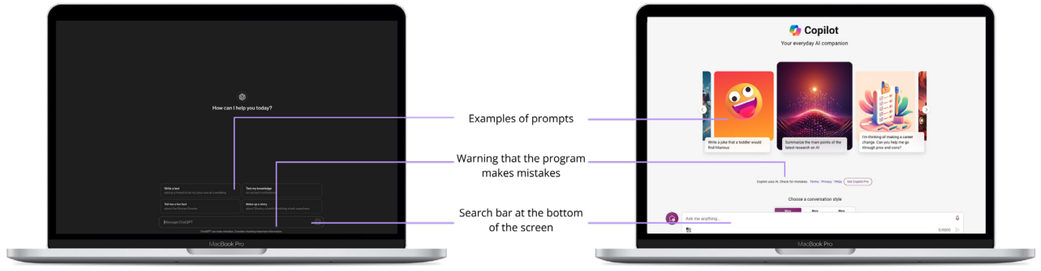


Figure 16: Comparison interface ChatGPT and Copilot

6.3. User involvement

Throughout the design phase, user involvement played a crucial role in the development of the concepts. By involving users in the concept development process, valuable insights, feedback and validation for our decisions were gained. This ensured that the concepts better met the needs of teachers. To facilitate user involvement, several feedback sessions for both the lesson module and the website were held. Surveys were also used to identify the needs and interests of teachers to ensure that their requirements were considered in the design. In addition, discussions and surveys with teachers were instrumental in evaluating and improving the usability of the website. The set-up of feedback sessions and discussions was inspired by the Convivial Toolbox methods of Sanders and Stappers, which emphasise the importance of directly involving the people we design for in the design process (2019). Detailed descriptions of the design and participants of these sessions and surveys are provided in the following chapters as they were conducted.

6.4. Conclusion

This chapter outlines the design methods used in the design phase of the project. These methods resulted in the desired concept qualities for the design of the project and two successful and functioning prototypes. Figure 17 shows the design methods and their results. These results are discussed in the following chapters.

Chapter	Design methods	Outcomes
Chapter 7: Design concept qualities	Brainstorm sessions	Out of the ordinary, collaborative, interactive
Chapter 8: The concepts & concept testing	Design-through-doing User involvement	Lesson module & website Concepts tailored to user needs

Figure 17: the design methods and their corresponding outcomes

Image generated by Dall-E 3

07

Desired concept qualities

As mentioned in Chapter 6, individual brainstorms and creative sessions were used to kickstart the design phase. Through these brainstorms, three desired concept qualities emerged. These concept qualities are: Out of the ordinary, Collaborative and Interactive. This chapter will elaborate on these concept qualities.

7.1. Out of the ordinary
7.2. Collaborative
7.3. Interactive
7.4. Conclusion

7.1. Out of the ordinary

The first criteria for the final design is Out of the ordinary. Discussions during the creative sessions highlighted the risk of relying on traditional methods commonly found in educational settings, which could result in the final design feeling mundane to students accustomed to routine learning experiences. Furthermore, research suggests a positive correlation between the degree of novelty in teaching methods and student engagement and motivation (Stupans et al., 2010; Benlahcene et al., 2020). Therefore, in order to promote engagement through novelty, it is crucial to develop an innovative solution that captures the interest of both teachers and students.

7.2. Collaborative

The design should facilitate the acquisition of GenAI knowledge and experience through collaboration. Numerous studies have demonstrated that interactions between teachers and students, or among students themselves, have a positive impact on student engagement (Abou-Khalil et al., 2021; Malikovna et al., 2022; Muzammil et al., 2020). Additionally, considering that the teacher we are designing for enjoys social interaction with students, collaboration is desired. Therefore, the second desired design quality is collaboration.

7.3. Interactive

The design should be interactive, meaning that both teachers and students are actively involved in the content of the design. Studies by Abou-Khalil et al. (2021), Malikovna et al. (2022) and Muzammil et al. (2020) have shown that interaction with school content is crucial for student engagement. Therefore, allowing students to interactively acquire GenAI knowledge will increase their engagement and understanding. For this reason, the desired final concept quality is interactivity.

7.4. Conclusion

The aim of this chapter was to summarise the results of the creative sessions. These sessions led to the identification of three desired concept qualities for the final design of this project: Out of the ordinary, Collaborative and Interactive. With these qualities established, the next chapter explores the search for existing products on the market that possess these qualities.

08

Concepts & Testing

As described in Chapter 6, a design-through-doing approach was used to develop and refine the concepts for CLD. Figure 18 illustrates the various tests and iterations of the concept prototypes that were carried out through this approach. In total, for three different concepts, prototypes were tested throughout the project. Two of these prototypes proved to be successful and functional: a lesson module and a website. All concept prototypes were tested using the Copilot GenAI programme. This chapter explores the details of all concepts and how findings through testing led to the development of the lesson module and website.

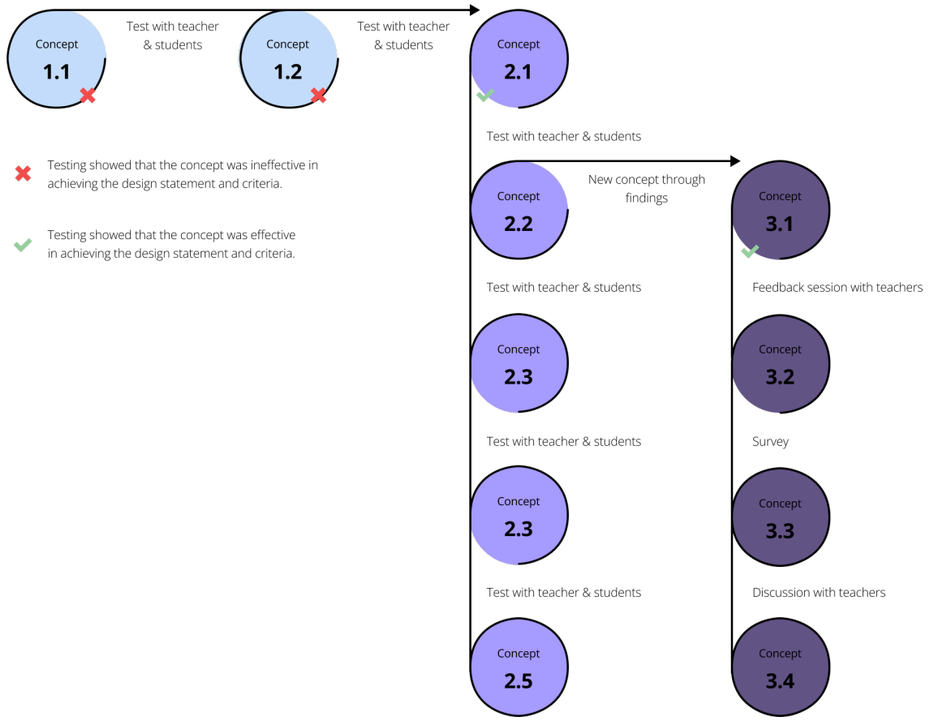


Figure 19: Process of all tests with concept prototypes throughout the project

8.1. Concept 1: Interactive online module
8.2. Concept 2: Lesson module
8.3. Concept 3: The website
8.4. Conclusion

8.1. Concept 1: Interactive online module

Interactive online module

8.1.1. Explanation of concept

As mentioned previously, the target audience for this project consists of social and motivated teachers who are open to change if it benefits their students. Therefore, the aim of this concept is to increase students' understanding of GenAI and raise awareness of its risks for future use. Given that many teachers emphasised the importance of students acquiring knowledge about GenAI, it is expected that they will embrace the implementation of this concept in their classrooms.

To achieve an understanding of GenAI, the first concept consists of an interactive online module designed to educate students about GenAI. Students can engage with the concept on their laptops and it's structured to be completed within a 50-minute lesson. In addition, teachers can use the concept to enhance their own understanding of GenAI. The concept prototype has been developed using Figma. Figure 19 shows an example of one of the screens of the prototype.

Out of the ordinary

This concept is exceptional in that it allows students to learn interactively through a digital module without direct instruction from their teacher. It provides a unique and engaging learning experience for both teachers and students.

Interactive

Throughout the module, students engage in hands-on exercises on paper that simulate the steps involved in training a GenAI programme. This interactive approach encourages active participation and facilitates a deeper understanding of the content. Figure 20 on the following page, shows an example of one of these hands-on exercises.

Collaborative

To assess students' learning outcomes, they work in pairs to create a poster showcasing their newfound knowledge, using the GenAI programme called Copilot. This collaborative activity promotes teamwork and enhances the learning experience. A Miro board was used to facilitate poster creation and consolidation.

Figure 19: Example of a screen students would see

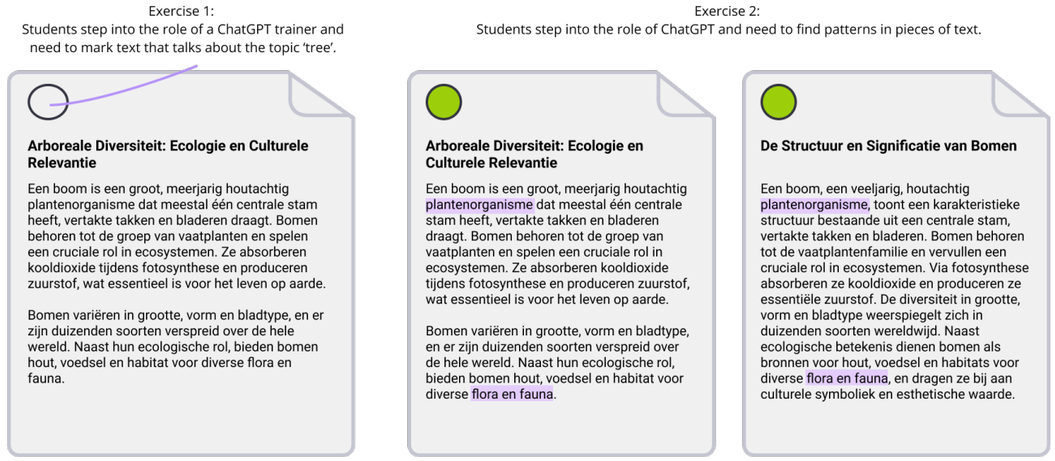


Figure 20: Part of the first two exercises done on paper

8.1.2. Findings

The tests were carried out with two classes of senior general secondary school students aged between 16 and 17. Appendix H provides a full discussion of the design and the tests conducted. In this section, the key findings that have influenced the further development of the project are discussed.

Observations during testing revealed that students swiftly navigated through the interactive model with the aim of completing it as quickly as possible. Their rapid clicking through the screens of the concept rendered it impossible to read the content displayed. Furthermore, students opted to use the Miro board for recreational purposes instead of engaging in the intended activity of poster-making. In a discussion after testing, the teacher mentioned the concept had overwhelmed students with information and strayed too far from traditional teaching methods, leading to a lack of student motivation. Based on these insights, a conclusion can be drawn that the final design should not be too far Out of the ordinary.

In addition, limited student-teacher interaction was observed. The teacher had to constantly check if students were actually working. Given that the primary goal of this project is for teachers to gain knowledge and experience of GenAI while socially interacting with students, this concept does not align with the design direction of the project. Consequently, this concept will not be pursued further.

Nevertheless, the testing of this concept provided valuable insights that helped set new goals for the next concept. These goals were:

1. To create a more traditional setup for the concept
2. To ensure the teacher is more involved
3. To ensure that students don't feel overwhelmed by the amount of information available on GenAI, it's important to manage the amount of information provided.
4. To restrict the amount of freedom students are given in exercises
5. To ensure motivation of students through incentives
6. To provide assistance in prompting

A new concept was created based on the goals above and the principle of constructive alignment by Biggs & Tang (1999). This principle is used in education to determine the learning objectives, activities and accompanying assessment. The next section delves into this concept.

8.2. Concept 2: Lesson module

Lesson module

With the updated goals in mind, a new concept has been developed that is in line with the traditional teaching format used at CLD. This concept follows a structured approach where the teacher provides an introduction and explanation of the lesson topic, followed by the students working on related assignments. By adopting this format, the aim of creating a concept with a more traditional structure is achieved, while at the same time involving the teacher more in the process. To ensure that the new concept did not duplicate existing ideas, a search was made for existing lesson modules that matched the design direction and desired concept qualities.

8.2.1. Existing products

A review of existing lesson modules was conducted to identify those that could facilitate social interaction between teachers and students while enhancing teachers' understanding of GenAI. The evaluation criteria included the ability of the products to be implemented within a 50-minute timeframe and to require minimal teacher preparation. The level of interaction and collaboration the lesson modules could achieved between teacher and students were also considered. Despite the search, no products fully met these criteria. However, eight lesson modules were identified as valuable sources of inspiration for our concepts. A detailed overview of these products can be found in Appendix G.

The lesson modules provided valuable insights into the materials teachers need to deliver an effective lesson (see Figure 21). In addition, existing lesson modules provided guidance on how to design clear exercises for students, emphasising the importance of encouraging reflection on the use of GenAI by documenting their preferences and concerns. Although two websites offering GenAI exercises for students were identified, most of the activities required more than 90 minutes or multiple sessions to complete, which was not in line with the desired criteria of achieving the concept within a 50-minute timeframe. Nevertheless, these exercises served as inspiration for the development of activities within our concept.

Figure 21: Example of what is presented to teachers to be able to use a lesson (Digi-doener! | Nationale AI-cursus Junior 1 | Kunstmatige Intelligentie, 2019)

8.2.2. Design rationale

As mentioned previoulsy, the CLD teaching format has been used in the development of the concept to ensure immediate teacher involvement. To ensure motivation of students through incentives, the principle of constructive alignment by Biggs & Tang (1999) was used. In this principle, one looks at the learning objectives, activities and the assessment. Learning objectives are what students should be able to know or do after a lesson. Learning activities are how students achieve the learning objective. Learning assessments are used to measure the level of achievement of the learning objectives among students. Through assessments, the model ensures the presence of incentives. Figure 22 shows the learning objectives, activities and assessment for the new concept.

Learning objectives

There are two learning objectives for the concept. Learning objective 1 is to acquire the necessary GenAI knowledge. Learning objective 2 is to gain experience and criticism when using GenAI. These objectives are based on the problem statement and design direction proposed in the research phase.

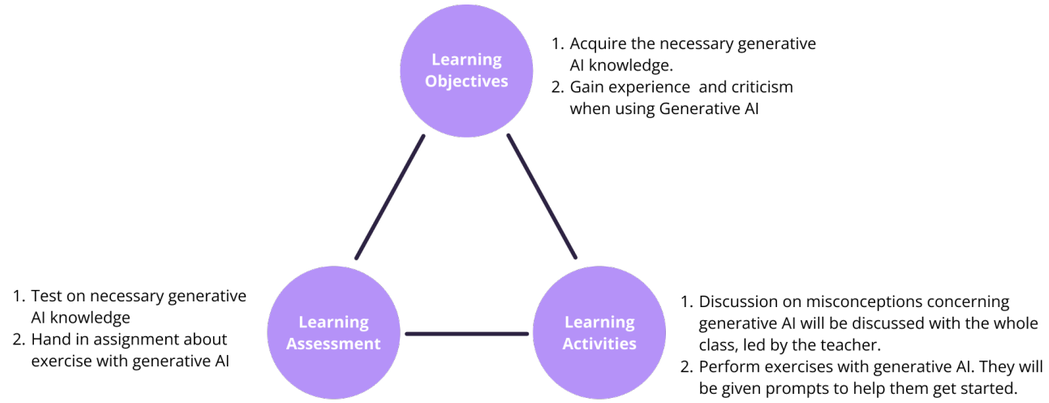


Figure 22: Visual made based on the principle of constructive alignment (Biggs & Tang, 1999)

Learning activities

How is learning objective 1 achieved?

When testing concept 1, it was observed that statements on GenAI triggered discussions among students and encouraged them to reflect on the content. Therefore, statements are used to achieve learning objective 1. The teacher presents statements about GenAI knowledge to the students and allows students to comment on them. This ensures that the GenAI knowledge is shared with the teacher and the students, without bombarding them with information. Through this, the goal of retaining the amount of information given on GenAI is achieved.

How is learning objective 2 achieved?

To achieve learning objective 2, students engage in exercises using GenAI to gain hands-on experience and provide feedback. The exercises include clear instructions for students to follow to ensure they are guided throughout the process. In addition, students are provided with sample prompts to help them get started. This approach limits the amount of freedom students have in the exercises, but also provides them with prompting support to facilitate their learning experience.

Learning assessment

How is learning objective 1 measured?

In order to motivate students through incentives, a test is done to measure learning objective 1. These tests can be administered using different methods such as an online platform, oral questioning or written exercises. For the first four tests, an online platform was used that rewards students with the highest number of correct answers. This competitive element is intended to encourage active participation in class (Burguillo, 2010; Cantador & Conde, 2010). For the final test, the test questions were discussed verbally with the class. Students were encouraged to raise their hand if they believed a particular answer to be true, and the teacher would then select students to elaborate on their answers. Both the online and oral approaches were effective in assessing learning, but the oral approach offered additional benefits. It facilitated engaging discussions and enabled the teacher to provide immediate feedback on students' responses, thereby enhancing the overall learning experience.

How is learning objective 2 measured?

To measure learning objective 2, students are asked to hand in their work at the end of the class with their teacher. This allows the teacher to measure whether students were able to achieve learning objective 2. Additionally, students know that whatever they put down on paper will be checked by their teacher, which in turn should motivate them to actually work on the assignment.

8.2.3. Lesson module structure

With the learning objectives, learning activities and assessment in place, a lesson module was created. This lesson module consists out of two parts: The first part contains learning objective 1 and the second part contains learning objective 2.

Part 1: Acquiring the GenAI knowledge

The lesson module starts with the teacher introducing the topic of GenAI through a brief explanation, supplemented by examples of GenAI content. The teacher then asks the students to share their understanding of what ChatGPT is. Following up to this, statements are presented to the students concerning the GenAI knowledge we want the teacher and students to obtain. This knowledge includes:

1. GenAI contains a bias
2. GenAI has an impact on privacy
3. GenAI hallucinates
4. ChatGPT 3.5. does not have a real live connection to the internet.
5. GenAI generates new content.

Topic 4 and 5 were added after testing concept 1. It was found that most students believe that ChatGPT has a live connection to the internet, which is false. Additionally, in brief conversations with teachers in the teachers' lounge between tests, teachers compared ChatGPT to a parrot. This implies ChatGPT copies text from its database and does not create new content. While the resulting text from GenAI will have similarities in style and structure to the database, it's not just a copy and paste.

After using the statements to discuss these topics, students take a short test to assess their retention of the information. Through these assessments, students and teachers acquire GenAI knowledge collaboratively in an active and engaging way.

Part 2: Gain experience and criticism on GenAI

Students will work in pairs to complete GenAI exercises designed to give them hands-on experience. These exercises will introduce students to a GenAI programme and guide them through its use. Figure 24 shows the exercise menu that appears in the final iteration of the lesson module. These exercises are designed to educate students about the importance of prompts and allow them to explore the capabilities of GenAI, while also raising awareness of the risks involved. Teachers have the flexibility to select any exercise to include in the lesson module. A comprehensive overview of all the exercises developed and tested during the project can be found in Appendix J.

As GenAI is not yet widely integrated into the classroom, these exercises provide a novel approach for students to actively engage with the lesson content. By interacting with GenAI programmes, students gain practical experience in an interactive way. In addition, working in pairs allows students to provide collaborative feedback, share experiences and gain insights from each other. Therefore, all desired concept qualities are present in this concept.

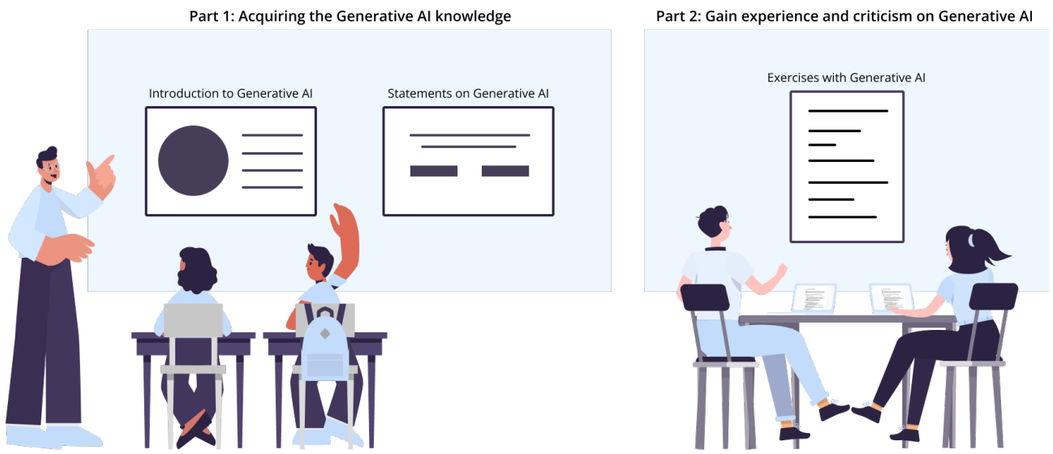


Figure 23: Lesson structure for the lesson module

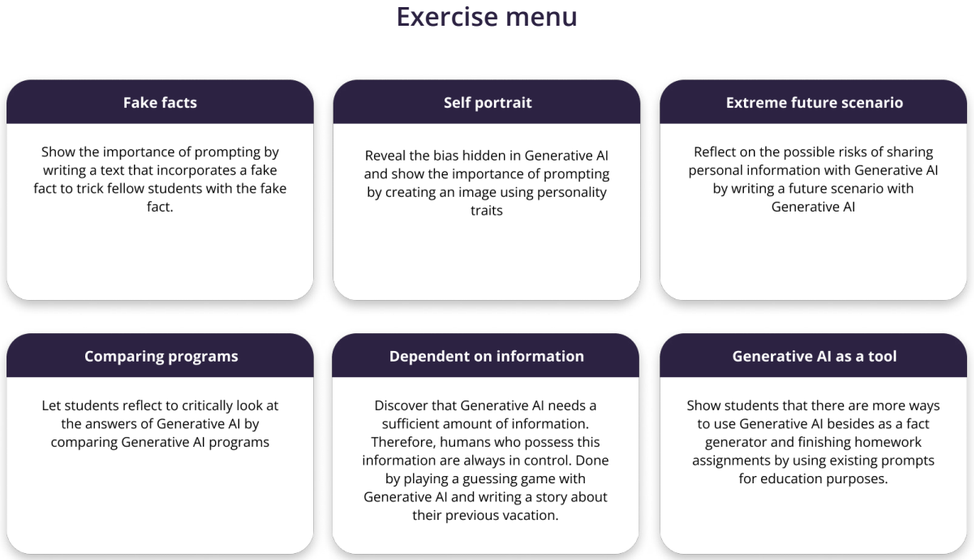


Figure 24: Exercises with GenAI included in the final version of the lesson module

8.2.4. Teaching materials

In order to ensure that teachers can implement the lesson module without the help of the designer and to limit their preparation time, all the necessary teaching materials were created. After testing the concept multiple times, the final materials are:

- A teacher's guide that includes the lesson structure, the aim of each part of the lesson and what the students will learn and do
- A slide deck containing information and statements about GenAI
- A teacher answer sheet for the correct answer for the statements
- A handout on prompts and use cases
- A student assignment sheet for the exercises with GenAI

As many teachers at CLD use Google Docs and Google Slides, all teaching materials are stored on a Google Drive and shared with the teachers at CLD. A complete overview of all iterations done through testing can be found in Appendix J.

8.2.5. Testing

Thanks to the cooperation of several teachers, the lesson module was tested a total of five times, with each test conducted in a different classroom with a different teacher. As the availability of teachers and classes varied, there was no control over the specific demographics of the students involved in the testing process. However, this provided an opportunity to assess the applicability of the teaching approach across different age groups and student levels. The goal of testing the lesson module was to see whether it can be used to let teachers and students gain GenAI knowledge and experience while socially interacting with one another.

The tests involved a teacher using the concept to deliver a lesson on GenAI. One week prior to the test, teachers received all materials via email and were asked to watch a short video about GenAI and try out two prompts in Copilot. This preparation was intended to help them feel more comfortable and prepared for the upcoming

lesson. During the testing sessions, the designer was present solely to observe the proceedings. Figure 25 provides a visual depiction of the classroom setup during the tests.

Following each test, teachers were asked about any difficulties they encountered in preparing the lesson and their thoughts on the content, test questions, and assignments.

Figure 25: Classroom setup during testing

Following the initial test, the concept was found to be a success: the participating teacher was able to execute the lesson module; students scored an average of 90 out of 100 on the test; and students worked attentively on the exercises with GenAI. Additionally, it was observed that both teacher and students enjoyed the lesson, with many instances of laughter observed.

As a result, it was decided to continue testing the concept in order to improve the lesson module. Following each test, the insights gained were used to refine the lesson module and materials. A range of exercises involving GenAI were trialled during each test to provide the school with a diverse selection of tested exercises. Table 5 below provides an overview of all the tests conducted at CLD. Appendix I discusses the research setup for testing the concept.

Version of concept	Class	Teacher
Concept 2.1 Exercises: Fake facts Self-portrait	VWO3	English
Concept 2.2 Exercises: Future scenario Brainstorm	HAVO5	Science
Concept 2.3 Exercise: Extension brainstorm with prompting	HAVO5	Biology
Concept 2.4 Exercise: Dependent on information	VWO2	German
Concept 2.5 Exercise: Comparing programs	VWO5	Science

Table 5: Overview of tests with concept 2 at CLD

8.2.6. Additions and iterations

In all the tests conducted, the teachers were able to execute the lesson model while students actively engaged with the teacher's instructions and completed the assigned exercises. Different classes exhibited different patterns of behaviour, with some classes being particularly noisy and others maintaining a quieter atmosphere. In some classes, several students actively participated in discussions and shared their perspectives, while in others only one or no students contributed to the conversation. Although there were a few instances of students not concentrating on the task at hand, the majority remained focused.

The learning assessments showed that students gained both knowledge and practical experience of GenAI. Across all tests, students achieved high scores on the GenAI-related test questions. In addition, the majority of students successfully completed the exercises using the GenAI programme.

The next section will examine how insights gained from the tests have influenced subsequent iterations of the lesson module and facilitated the integration of supplementary materials.

Level of difficulty of test questions

In the first two rounds of testing, the difficulty of the test questions was deliberately kept simple and concise. This was done to ensure that the questions were not overly challenging and only served to assess whether the students had listened to their teacher's instructions. In both tests, the students achieved high scores with an average of 80 out of 100. However, after the second test, the teacher suggested that the test questions be made more challenging. Subsequently, the test questions were made more difficult by introducing multiple-choice options instead of true/false statements. Despite this adjustment, students continued to perform well on the tests in subsequent rounds. This shows that all students listened and participated and had acquired the necessary GenAI knowledge.

Create room for discussion

While students generally performed well on the tests about GenAI knowledge, their reasoning was often incorrect. Next to that, students often gave short answers on the assignment sheets, making it difficult to assess their understanding of the material. Figure 26 gives an example of the short answers given by a student. Despite several attempts to elicit more in-depth responses from students, these efforts proved unsuccessful.

The experiences that students openly shared with their teacher and students in Part 1, were more interesting than the answers they gave on the assignment sheet.

Beantwoord de volgende vragen:

1. Heb je nieuwe manieren geleerd waarop je Copilot voor school kan gebruiken?

[nee]

2. Welke manieren heb je geprobeerd te doen met Copilot?

[alle 3]

3. Wat vond je ervan om Copilot te gebruiken op deze manier? Was het behulpzaam?

[ja]

4. Zou je dit in de toekomst gebruiken?

[ja]

Figure 26: Answers of student on assignment sheet

Part 1 of the lesson module turned out to be a great conversation starter for both students and teachers to share opinions and experiences related to GenAI. For example, one student commented that ChatGPT generated poor-quality images and suggested using an alternative programme. In another case, a student raised the issue of people creating songs using the voices of deceased artists. In addition, the teacher shared examples of students using GenAI to imitate the voice of a former Prime Minister to announce school events. These discussions provided a platform for students and teachers to share knowledge and experiences with GenAI. In addition, when students shared their understanding of how ChatGPT worked, the teacher was able to guide them towards a more accurate understanding.

Due to the effectiveness of these discussions in improving understanding of GenAI, it was decided to allow more time for discussion by removing the formal test

"I paste the code into ChatGPT and ask it where the error is and then I know immediately."

"If I need to write an essay and I don't know how to start I ask it (ChatGPT) to give ideas and than I have a base to start with"

used to assess learning objective 1. Instead, the test questions were integrated within the statements used for discussion, creating discussion questions. This allows the teacher to discuss the correct answers and explain the reasoning behind them.

Finally, the lesson module concludes with a discussion session where students can share their experiences and insights gained from the exercises. This approach encourages collaborative learning and a deeper understanding of the topic among students and allows the teacher to learn from the experiences of the students.

Additional answer sheet for discussion questions

Before Test 4, the assigned teacher had to leave unexpectedly and was unable to conduct the lesson. A substitute teacher was brought in at short notice to deliver the lesson. However, this substitute teacher was unprepared for the lesson and lacked knowledge of GenAI, making it difficult to provide the class with additional explanations or to facilitate discussion questions effectively. Despite this, the students expressed a need for explanation. To overcome this challenge, it was decided to create a teacher's answer sheet containing the answers to all the questions in the slide deck. This would enable substitute teachers or teachers unfamiliar with the topic to provide accurate explanations and facilitate discussions effectively, ensuring a smoother delivery of the lesson in similar situations in the future.

An additional handout on prompting and use cases

Prompting

During the tests, three out of five teachers emphasised the importance of teaching students how to prompt correctly. One teacher gave an example of a pair of students who had to write a report and had used ChatGPT incorrectly. The students did not understand that prompting ChatGPT to write a scientific text would result in content written at the level of a scientific paper, but not necessarily including real literature sources. The other two teachers also expressed the hope that students would learn how to improve their prompts.

As a result, slides on how to prompt were added to the slide deck and an additional prompt sheet was produced to be given to students as they worked through the exercises to reinforce the importance of proper prompting techniques.

Use cases

Additionally, some students mentioned that they were surprised at how useful GenAI can be for school, but at the same time were not sure if they would use it because of its trustworthiness. They were cautious about using GenAI for school. Reasons for not using ChatGPT for school were fear of getting caught, not trusting the results, or fear of getting dumber by using it. These reservations again show that students use GenAI in one specific way; which is searching for information.

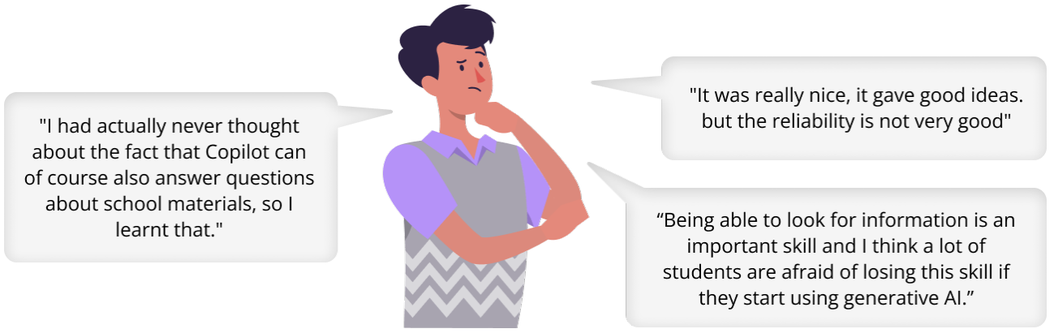
Nevertheless, GenAI can help improve your writing, help you brainstorm on ideas, make a practice test for an upcoming exam, etc (Skrabut, 2023). As a result, a handout of use cases for GenAI was created, based on the paper by Mollick & Mollick (2023) and a prompt library created by two Dutch teachers (Naberink & Mutsaarts, 2024). This ensures that students know the possibilities of GenAI.

An additional concept

Through testing, two teachers demonstrated that providing prompts and information about GenAI lowered the barrier to starting to use it.

One teacher, who was initially overwhelmed by GenAI, found the two prompts for Copilot to be a catalyst for starting to use it. After trying Copilot for course explanations and exercises, she was enthusiastic and continued to experiment with the tool for creative writing assignments and presentations. Two weeks later, during the test, she was already making recommendations to the students on how to use Copilot.

Another test involved a teacher who had



also previously felt unsure about where to start with GenAI. At the beginning of the test, she shared an email from the AI Inspiration group that contained a prompt and link to Midjourney, a GenAI programme that generates images. She mentioned that she had used it and had shared her experiences with the programme. This shows that the email provided sufficient information for the teacher to use the GenAI programme.

These cases highlight the effectiveness of providing prompts and information to facilitate the adoption of GenAI. As a result, an additional concept emerged: the creation of a dedicated website for teachers. This website, aimed at providing inspiration and information about GenAI and the lesson module, is described in more detail in Chapter 8.3.

8.2.7. Feedback session with AI inspiration group

Teacher feedback was sought to improve the quality of the exercises and test questions, facilitated through an online session using Canva Whiteboard. Details on the full set up can be found in Appendix K. Feedback on the exercises and test questions was given by three teachers from the AI Inspiration group, each with different areas of expertise provided valuable input. Their characteristics can be found in Table 6.

Overall, they found the exercises valuable and relevant, providing a solid introduction to GenAI while teaching important concepts. The teachers confirmed all exercises were suitable for junior students and recommended their use for senior

Characteristics	# of teachers
Job title	
Deputy headmaster	1
ICT coordinator	1
Examination board	1
Gender	
Male	1
Female	2
Total	3

Table 6: Overview of teachers interviewed

secondary school students who currently lack sufficient knowledge about GenAI.

Finally, they suggested to remove specific GenAI programme names and refine the questions using Bloom's Taxonomy, which categorises educational objectives into different levels of complexity. After reformulating the questions, they were reviewed and approved by a member of the examination board.

8.2.8. Level of interest for a lesson module

A survey was conducted to measure whether teachers at CLD would be interested in a lesson module on GenAI. The survey, which was published in the school's weekly digital newspaper and distributed to all teachers, asked about their interest in a lesson module and a dedicated website on GenAI. All survey questions can be found in Appendix L.

21 teachers responded to the survey. Table 7 provides an overview of the characteristics of the teachers. As depicted in Table 7, only a quarter of the teachers have not used ChatGPT, and half of them hold a positive attitude towards ChatGPT. Consequently, the outcomes of the survey may reflect a particular view of teachers. However, since our current focus is on targeting teachers with an interest in ChatGPT, this is not considered a limitation at present. Furthermore, the Table illustrates a diverse range of subjects taught by the teachers, ensuring a wide representation of different teacher backgrounds among those interested in AI.

Characteristics	# of teachers
ChatGPT usage	
Yes	16
No	5
ChatGPT attitude	
Positive	10
Negative	0
Neutral	10
Subject they teach	
Physics	1
Dutch	5
Science	1
Drawing	1
German	1
Mathematics	1
Gymnastics	1
English	1
Geography	1
Religion	1
Biology	2
Economics	1
Total number of teachers	21

Table 7: Overview survey Participants

As Figure 27 shows, the survey revealed unanimous agreement among all teachers that the inclusion of GenAI in the student curriculum is considered necessary. Figure 28 shows teachers' responses to the open question of what students should learn about ChatGPT. Of the 21 teachers surveyed, 7 emphasised the importance of teaching students to use it responsibly, while warning against potential abuses, such as generating entire reports. Conversely, others emphasised the importance of educating students about both the opportunities and risks associated with GenAI, preparing them for future advances in the field. Importantly, teachers noted a widespread lack of sufficient understanding among both teachers and students, underscoring the need for our project's design focus. As a final question, teachers were asked if they would like to have access to the lesson plan we created. 18 out of 21 teachers requested access to this lesson plan, which shows that the level of desire for a lesson module on GenAI is high.

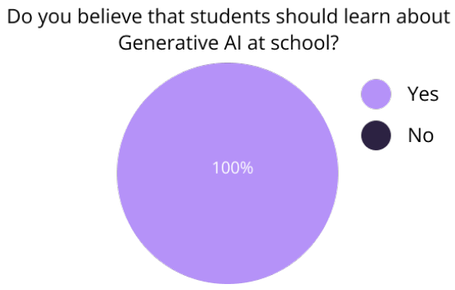


Figure 27: Results of the survey

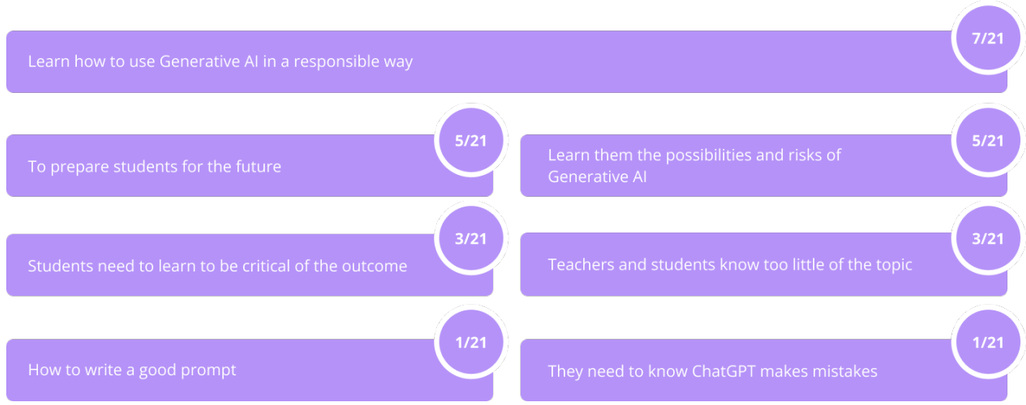


Figure 28: Teachers' responses to the open question of what students should learn about ChatGPT

8.2.9. Findings

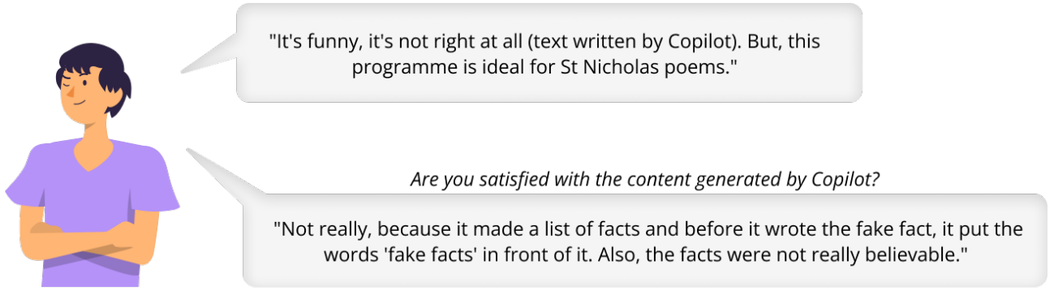
Testing confirmed that the lesson module effectively facilitated the acquisition of GenAI knowledge and experience for both teachers and students within a 50-minute class period. During this time, teachers and students explored the concept of GenAI, discussed the risks involved, and gained hands-on experience with GenAI programmes.

The most notable aspect across all evaluations was the active engagement of students and teachers in discussions around GenAI. These exchanges allowed students to share their knowledge and experience with their peers and teachers. At the same time, teachers were able to share their own insights and knowledge about GenAI with students, fostering a dynamic two-way exchange of information.

In addition, the exercises included in the module allowed students to gain hands-on experience with a GenAI programme. Through these exercises, students discovered that GenAI programmes can produce unexpected or unconventional results, emphasising the importance of the input prompt. In addition, working in pairs increased students' motivation and engagement as they shared their findings and experiences, enriching the learning process.

At last, teachers also expressed an interest in the lesson module. In addition, the survey at CLD showed unanimous support among teachers for integrating GenAI into the curriculum. While 7 emphasised responsible use, others emphasised educating students about the opportunities and risks.

As mentioned before, the lessons learnt from testing the lesson module have led to the development of an additional concept, which is described in more detail in the following section.



8.3. Concept 3: The website

The website

8.3.1 Reasoning for the website

As previously indicated in the research phase, some teachers expressed feelings of overwhelm or intimidation in relation to GenAI. This was caused by either not knowing where to start, or they felt uncomfortable not knowing how GenAI generates content. Nevertheless, they remain open to exploring the potential of GenAI, driven by a desire to understand its capabilities.

During the testing phase of the lesson module, it was observed that the provision of prompts and information on GenAI can facilitate the adoption of this technology. In discussions with the school on this matter, it was decided to create a website dedicated to this topic. The objective of the website is to provide information on GenAI and offer guidance on its use. As previously stated, teachers have limited time available. Therefore, it's essential to present the information on GenAI in a concise and accessible manner.

8.3.2. Level of interest for a website

In Chapter 8.2.6, the survey conducted at CLD to ascertain teachers' interest in a lesson module was also used to measure the interest in a website about GenAI. As Figure 29 shows, results from this survey show 19 out of 21 teachers expressed a desire to learn more about GenAI. While 8 teachers sought practical application, another 8 wished to understand its capabilities first. Some expressed interest in student applications, while others in detection methods. Furthermore, 18 teachers expressed interest in a dedicated GenAI website. The elements the teachers would like to learn about were used as guidelines for the content of the website.

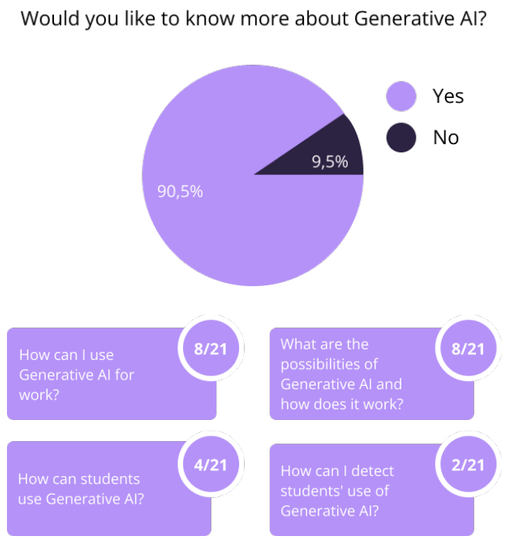


Figure 29: Results of survey on learning more about GenAI

8.3.3. The website

Following a feedback session on the initial concept of the website by the AI inspiration group, a second version was developed. This version underwent further evaluation via a survey distributed to teachers, supplemented by in-person reviews by three teachers. Feedback gathered through these channels informed the development of the final website, which includes the following pages:

Home page - to inform and inspire teachers

The AI inspiration group mentioned that the website should provide more inspiration to lure teachers in. In addition, the website should provide a clear explanation of what GenAI is. Therefore, the goal of the homepage is to inform and inspire teachers.

Learning page - to learn about GenAI

As teachers should be able to explain GenAI knowledge to students, it was decided to create a page dedicated to this. Therefore, this page contains videos explaining how ChatGPT generates text, the statements used in the lesson module, and examples of GenAI generated content.

Experiment page - provide prompts to try out GenAI

As teachers had requested in the survey to learn how to use GenAI, the Experiment page was built. This page explains how to write a prompt, gives examples of prompts and displays several GenAI programmes for teachers to try. The AI inspiration group mentioned that it should be very clear how to access ChatGPT, so that less tech-savvy teachers in the school can access ChatGPT as well. Therefore, a video was made that shows how to access ChatGPT step by step. Additionally, teachers wanted to know how they could use GenAI for their work or for teachers. As a result, several websites containing prompt libraries for teachers' use were also linked to on the website.

Lesson page - The lesson module

Besides providing the teachers with information and inspiration of GenAI, it was also desired to provide them with the lesson module. Therefore, the Lesson page was created.

Misuse page - provide tips on how to detect GenAI

A small group of teachers requested for tips on how to recognise when students are using GenAI. As this is still difficult, it's not possible to provide teachers with a lot of information. However, this page provides tips and examples on how to better detect misuse.

About Us page - provide information on the maker of the website

Finally, a page is added to provide information on why this website was built and who built it.

In the following sections, core elements of the website will be discussed to explain certain design decisions.

Youtube videos

Previous tests of the lesson module showed that the short YouTube video distributed to teachers prior to the start of the tests proved to be an effective means of familiarising them with the principles of ChatGPT. This approach was deemed to be both efficient and straightforward in enhancing teachers' understanding of the topic. Consequently, it was determined that utilising existing YouTube videos on GenAI would be beneficial to inform teachers on the topic (see Figure 30).

Examples of GenAI and quotes from students

During the feedback session with the AI inspiration group on the first version on the website, it was mentioned that the homepage of the website should lure teachers in by showing examples of what GenAI can do. Therefore, several examples are presented on the Home page. Also, quotes from students are used. This is meant to show teachers what students do with GenAI and motivate them to learn about GenAI. These quotes were gathered by Codename Future, an organisation

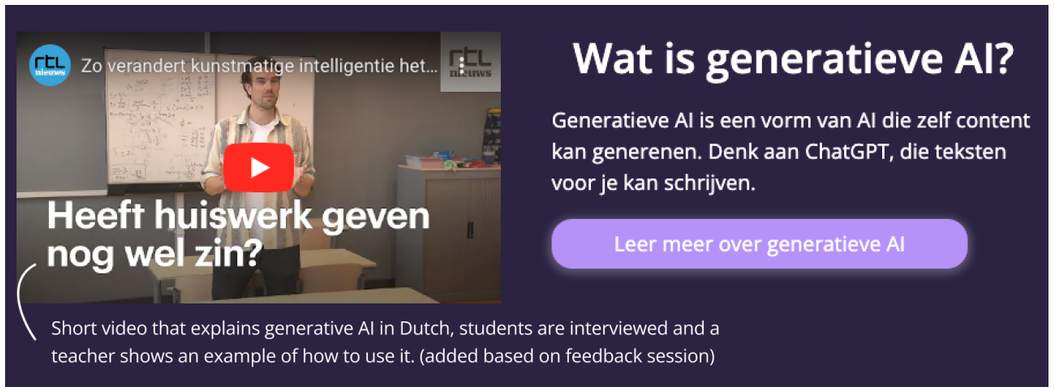


Figure 30: Youtube video to explain the workings of GenAI

that wants to prepare students for the future (Young Reporters, 2023). Figure 31 shows the examples of GenAI on the Home page and example of a quote used on the website.

Figure 31: Examples of GenAI and quotes of students to trigger teachers

How to write a good prompt

During testing of the lesson module, teachers had mentioned that students should learn how to prompt. The AI inspiration group and previously mentioned results from the survey also indicated that this was desired for teachers. For this reason, it was decided to also explain this on the website. Figure 32 shows the section on the Experiment page of the website that explains how to write a good prompt.

Figure 32: How to access ChatGPT and explanation of what a good prompt is

The lesson module

As mentioned before, the lesson module was also added to the website. Figure 33 shows all the information presented about the lesson module on the Lesson page of the website.

Figure 33: Lesson page

8.3.4. Improvement and evaluation of website

Survey

To improve and evaluate the website, a survey was used. The goal of the survey was to assess whether the site adequately meets the needs of teachers and whether it is sufficient in terms of usability.

In the previous mentioned survey, 18 teachers mentioned wanting to gain access to the website. Therefore, they were sent the link to the website with a request to fill in the survey. Nine teachers replied to the survey. Table 8 shows the characteristics of the teachers. As the Table shows, the site was evaluated by a wide range of teachers.

The survey asked about the courses and age groups taught by teachers, as well as their views on GenAI. It also asked teachers about their learning experiences with GenAI on the platform and to identify any missing features or information on the website.

To assess the usability of the website, the Sustainability Usability Scale (SUS) is added. This is a post-test assessment created by John Brooke to measure how easy a product is to use (1986). It contains 10 statements and teachers can indicate how much they agree with the statements on a scale of 1 (Absolutely disagree) to 5 (Absolutely agree). The full setup for the survey can be found in Appendix M. 9 teachers replied to the survey.

Figure 34 presents the outcome of the SUS assessment. The website scored 76 on the SUS, indicating 'good' usability. One teacher rated it below 68, indicating poor usability. This teacher mentioned to struggle with the website as they found it hard to find what they were looking for because they didn't scroll down enough on the pages of the website. The other eight teachers said the website was clear and had lots of beginner-friendly information on AI. Based on these findings, it can be concluded that overall the website scored good on usability.

Nevertheless, to ensure the website improves in usability, each page will contain an overview of what can be found on that specific page. Figure 35 shows how this is done on the Learning page of the website.

Characteristics	# of teachers
ChatGPT interest	
Positive and sees possibilities	1
Positive but hesitant	5
Interested, but not convinced yet	2
Not interested	1
Age of students they teach	
Junior	2
Senior	4
Junior & Senior	3
Subject they teach	
Geography	2
Biology	2
Science	2
Religions	1
Dutch	2
Gender	
Male	4
Female	5
Total number of teachers	9

Table 8: Overview Survey Participants

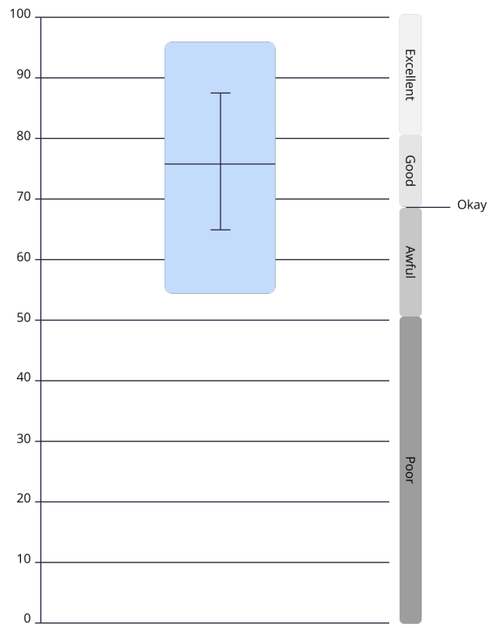


Figure 34: SUS score of website

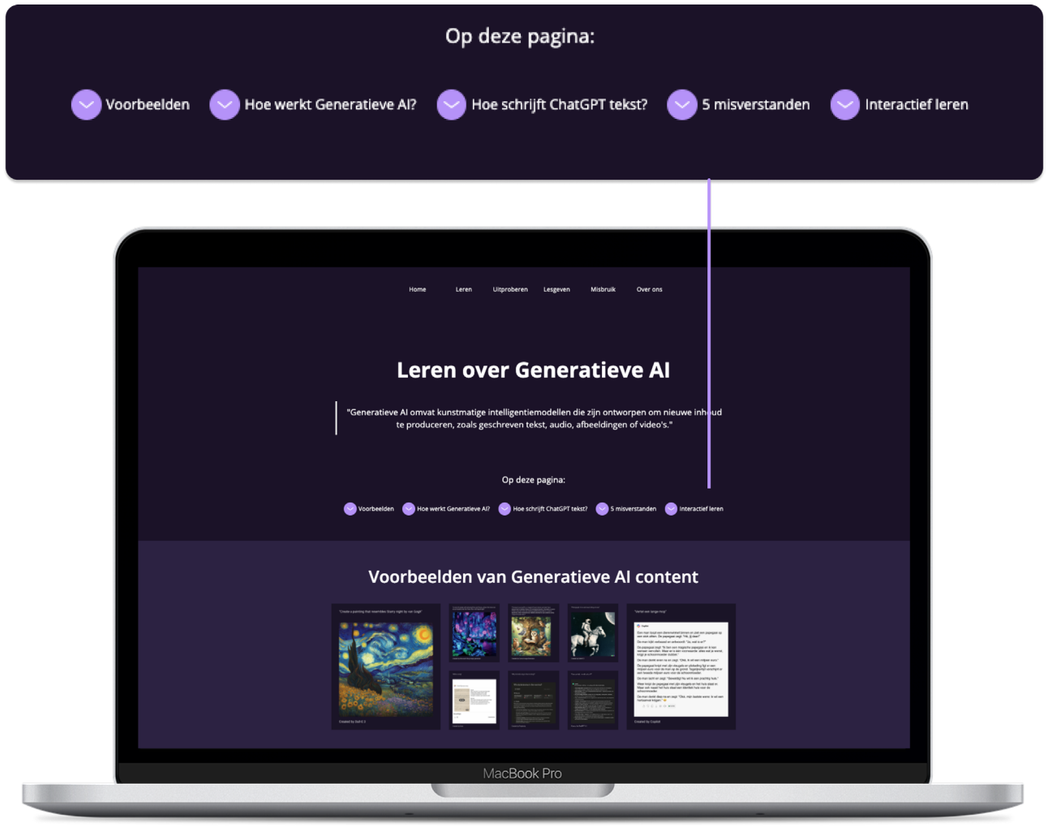


Figure 35: Overview on the top of each page to provide more insight on what can be found on the page

To measure teachers' understanding of GenAI, they were asked to note any new knowledge they gained from the website. One teacher acknowledged learning that certain features could be disabled (implying data retention by ChatGPT), while another gained an understanding of the biases in GenAI programmes. In terms of practical experience with GenAI, teachers gained insight into the appropriate use of the software and its ability to generate images, highlighting the comprehensive coverage of both theoretical knowledge and practical application on the website.

Teachers also found the lesson module interesting and identified exercises suitable for teaching GenAI to students. However, they expressed a desire for more subject-specific content on the site. Given the scarcity of research on such cases and our limited expertise, implementing such content is challenging. As a result, teachers are encouraged to experiment with relevant materials independently.

In addition, teachers have expressed interest in integrating AI into their teaching and professional activities, prompting us to increase the website's focus in this area. Therefore, a section was added that directs teachers to external resources with prompt libraries for classroom use or professional projects. This section was added to the Experiment page and is displayed in Figure 36.

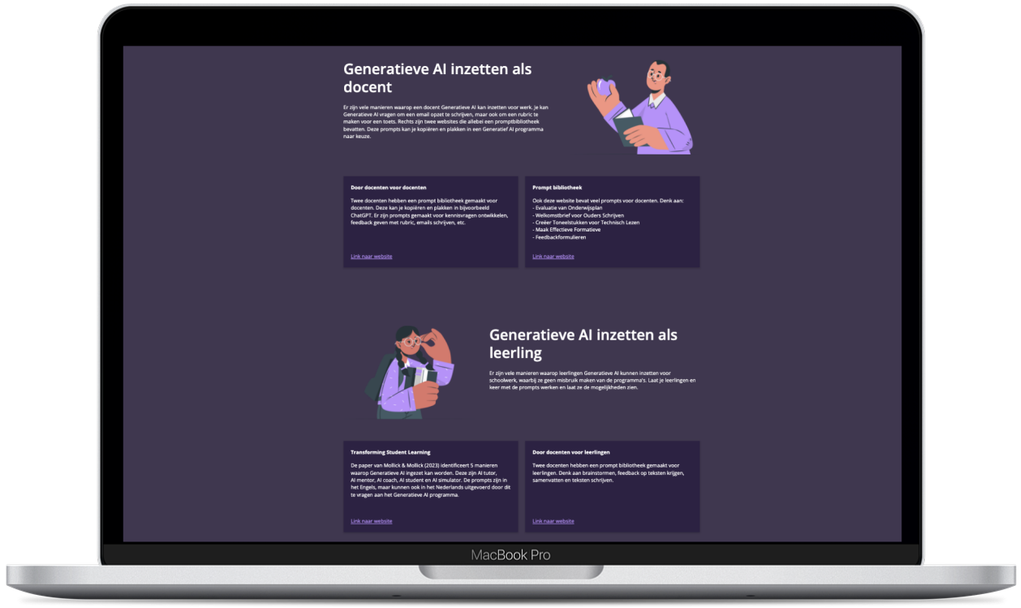


Figure 36: Experiment page section that informs people with links to prompt libraries

Presenting website to teachers

After the previous mentioned improvements were made discussions were held with three teachers of CLD about the promotion of the website within the school to ensure that the website reached its target audience. These teachers had limited exposure to GenAI and expressed a strong interest in learning more about it. This made them a suitable target audience for the platform. Table 9 gives an overview of the characteristics of the teachers who participated. The full research setup for the discussions with the teachers can be found in Appendix N.

During the discussions, the website was displayed on a laptop and the teachers were free to explore the site. By observing the teachers as they explored the site, small improvements could be made to the usability of the site. In this section, the teachers' thoughts on the website are briefly shared. The findings on promotion are reported in Chapter 9.

All three teachers expressed a desire to receive the link to the website for future reference and to share it within their respective departments. Interestingly, each teacher showed a preference for different aspects of the website. While one was attracted to the learning page, another was more attracted to the experimentation page. In addition, one teacher expressed an interest in exploring the GenAI programmes presented in the overview on the Experiment page, while another preferred to look more the section displayed in Figure 36. This diversity of preferences demonstrates the site's ability to meet the different needs of teachers.

Characteristics	# of teachers
ChatGPT experience	
Has used ChatGPT 1-3 times	1
No ChatGPT experience	2
ChatGPT attitude	
Positive	2
Neutral	1
Subject they teach	
Biology	1
Dutch	2
Gender	
Male	1
Female	2
Total	3

Table 9: Overviews of teachers who participated in the interviews

8.4. Conclusion

The aim of this chapter was to develop a concept that would enable teachers to actively engage in social interaction with students while gaining knowledge and experience in GenAI. A design-through-doing approach has been used to test and develop concept prototypes.

Testing of the initial concept revealed that the final design should not stray too far from conventional teaching methods, as non-traditional approaches failed to provide students with the necessary guidance, resulting in limited acquisition of GenAI knowledge. Consequently, for the remainder of the design phase, it was decided to temper the desired concept quality Out of the ordinary.

In the subsequent stages of the design process, two functional prototypes were developed and tested, yielding positive results. These prototypes include a lesson module and an informative website dedicated to GenAI. Both initiatives are designed to assist teachers by offering resources for personal and classroom use, thereby reducing the time spent searching for appropriate tools or information on GenAI and easing the transition into utilizing GenAI.

The lesson module serves as a catalyst for dialogue between teachers and students, fostering an environment where students can share their insights and experiences, while teachers reciprocate by sharing knowledge on GenAI. The module also includes exercises that explain the value of prompting and explore the opportunities and risks associated with GenAI, encouraging critical and responsible use of GenAI.

The website acts as a platform with knowledge on GenAI, with explanatory YouTube videos, illustrative examples and practical guidance on how to use GenAI tools.

The enthusiastic response from teachers to both the lesson module and the website is a testament to the success of these approaches. This positive feedback indicates that the concepts have effectively addressed the needs and expectations of teachers, establishing them as valuable tools for enhancing teaching and learning experiences related to GenAI.

09

Implementation

In the previous chapter, it was shown that both the lesson module and website have proven to be helpful concepts to educate both students and teachers on GenAI. To bridge the gap between our current efforts and the future implementation of GenAI in secondary education, a roadmap has been created according to the guidebook of Simonse (2017). By leveraging the website and lesson module, we aim to pave the way for integration of GenAI beyond the scope of our project. The final roadmap is presented as a separate PDF document. It is recommended to review this document before proceeding with this chapter. In this chapter, the roadmap will be discussed to explain the implementation steps for both the website and the lesson module. First, the vision for 2026 is outlined, explaining the desired state of education with the integration of GenAI. Next, the choices that guided the design of the roadmap are discussed. Finally, the rationale behind the horizons is outlined.

9.1. Vision
9.2. Shaping the roadmap
9.3. Horizons
9.4. Resources
9.5. Conclusion

9.1. Vision

As previously mentioned in Chapter 3, schools maintain an uncertain stance towards the integration of GenAI into education, awaiting official regulations from the government. However, students will keep utilising GenAI for schoolwork. Throughout this project, CLD and SCO Delft have gained insights and have access two concept prototypes for its use, positioning them as potential leaders in implementing GenAI in schools.

Therefore, the roadmap is focused on our clients, CLD and SCO Delft. From there, it extends beyond their school environment. This roadmap begins in the present and extends to 2026, aiming to achieve the following vision: ***"I envision a future where Christelijk Lyceum Delft & SCO Delft help teachers throughout the Netherlanders to be adapted to Generative AI by August 2026, while engaging in ongoing collaborative exploration."***

The goal of this vision is to ensure that not only CLD is adapted to GenAI, but that eventually all schools in the Netherlands are.

9.2. Shaping the roadmap

As noted in Chapter 8, three teachers from CLD volunteered to participate in discussions regarding the website and its promotion. These discussions led to the development of a roadmap aligned with the teachers' typical methods of skill development. To ensure its feasibility and suitability for both CLD and SCO Delft, the roadmap was collaboratively crafted with the ICT coordinator and deputy headmaster of CLD, along with the chairman of the board of SCO Delft.

The finalised roadmap is available as a separate PDF document. It is recommended that this document be reviewed prior to advancing to this chapter.

9.2.1. Integrating GenAI without adding to the workload of teachers

On of the biggest hurdles in education to integrate new developments like GenAI is the lack of time. Therefore, the main goal when creating this roadmap was to ensure that the integration of GenAI in education doesn't cause extra workload for educators. Through conversations with the deputy headmaster and the ICT coordinator, it was possible to create an implementation plan where both the website and lesson module are integrated through allocating existing time of teachers to work with them, without adding time to their current schedules. In the following sections, these solutions will be discussed.

Computer science subject

CLD is formulating a new curriculum for the subject Computer science which includes that students should learn about AI. This subject encompasses various facets of computing and technology, providing an ideal opportunity for the integration of AI. Therefore, this subject is a good place to start implementing the lesson module. As an assignment for the subject, students can explore ways to use GenAI programmes for their education. For example, they could focus on finding a GenAI programme for a specific subject they follow. As a delivery, students create an infographic that shows their findings. This way, students and teachers can collaborate on finding responsible ways to implement GenAI into education.

AI inspiration group

As mentioned earlier in the report, CLD has a group of seven teachers interested in AI in education. Unfortunately, only two to three consistently attend their scheduled meetings. Acknowledging this, discussions with the deputy headmaster resulted in a decision to carve out time within their existing schedules. As a result, during the school's five exam weeks throughout the year, members of the AI inspiration group are granted a day off from supervision duties. This designated day offers them the chance to convene and brainstorm potential implementations of GenAI in education without adding extra hours to their schedules.

Workshops and study days on GenAI

Each year, teachers benefit from professional development time, where they can study specific topics to improve their teaching practice or personal development. One way they do this is through workshops organised by the SCO Academy, a training platform within SCO Delft where teachers and experts give workshops. These workshops are open to all SCO Delft teachers and provide an ideal opportunity to introduce GenAI and to present the website for further exploration on GenAI.

In addition, SCO Delft organises study days for teachers within their schools, which replace the regular teaching days. These themed study days offer the opportunity to attend lectures and workshops. It's therefore proposed that CLD and SCO Delft organise an annual study day in the coming years to present the students' infographics from the subject Computer Science, share the results of the AI inspiration group and introduce the website and the lesson module.

Promotion

Newsletter

The school's weekly digital newsletter is an effective platform for promoting the website and successful implementations of GenAI, as it's widely read by all faculty members. Using the newsletter to share student infographics and new insights from the AI inspiration group can further increase teacher awareness and engagement.

Word of mouth

The teachers' lounge is a place for information exchange between faculty members, and provides an opportunity for the AI inspiration group to share its findings. In addition, as many members of the group are also ICT leads within their departments, they can use departmental meetings to share insights and updates on GenAI implementations.

Social media

Through discussions with teachers, it was found that they actively follow LinkedIn and teacher Facebook groups for updates on topics of interest. Leveraging these platforms by creating social media posts could effectively broaden the audience for GenAI and the website. Posting summaries of workshops and study days, along with tips on how to use GenAI programmes and directing users to the website, can help increase engagement and awareness among teachers.

9.2.2. The timeline

Schools rely on government regulations, guidance and planning from key stakeholders. Figure 37 illustrates all stakeholders that play a role in shaping regulations and guidance for secondary schools.

Figure 37: Stakeholders who shape regulations and guidelines for secondary education

These stakeholders include:

1. The Ministry of Education, which shapes policies.
2. SLO, responsible for establishing learning objectives for education.
3. The VO-raad, which collaborates with secondary schools and provides guidance on implementing the learning objectives.
4. SCO Delft, which formulates its own vision based on the guidelines provided by SLO and the VO-raad.
5. Christelijk Lyceum Delft, which shapes its own vision and curriculum based on input from all aforementioned stakeholders.

By adhering to the regulations and guidelines set by these stakeholders, secondary schools can effectively shape their educational strategies and curricula.

Consequently, the timeline for the roadmap has been designed in accordance with the regulations and guidelines provided by these stakeholders regarding GenAI in education. It also reflects the vision that CLD has cultivated with regard to GenAI. In the next section, the three horizons for implementing GenAI into education are explained based on the guidelines and regulations plans of the above mentioned stakeholders.

9.3. Horizons

To achieve the vision by 2026, the roadmap is divided into two distinct horizons. Horizon 1 runs from the present to August 2024 and horizon 2 runs from August 2024 to August 2026. The roadmap includes the driving forces that shape the future context of secondary education found during the research phase. These driving forces are placed on the timeline based on their current presence in education. It also includes an implementation plan for both the lesson module and the website, including the necessary technological advances and promotion strategies. Finally, the roles of relevant stakeholders are outlined to clarify their impact to each horizon.

9.3.1. Horizon 1 | Preparation phase

Let teachers of Christelijk Lyceum Delft gain Generative AI knowledge

In March 2024, SLO has shared their updated learning objectives for digital literacy (SLO, 2024). The updated learning objectives now include a section on AI, stating that students should be able to interact with an AI system in a purposeful, responsible and critical manner. They should also be able to use ChatGPT for tasks such as generating ideas or structuring text. The learning objectives also include the ability of students to explain how GenAI generates new content. As these topics are addressed in both the lesson module and on the website, it appears that these are well aligned with these learning objectives.

Based on these updated learning objectives, CLD is currently formulating a vision for the integration of AI within the school. Once finalised, this vision will be presented to the school management. They will then refine the vision in accordance with the vision of the SLO. Subsequently, based on this vision, a new curriculum for the subject of Computer Science will be developed before the start of the next school year. In light of these developments, it has been decided that Horizon 1, will run from the present up until August 2024.

Horizon 1 will be used to prepare the staff of CLD on GenAI before students have to be taught about it after summer. For this reason, we call Horizon 1 the Preparation phase. Computing Science teachers will have to prep themselves as they need to implement AI in their lessons after summer. All teachers interested in GenAI can use this phase before the next school year to learn more about GenAI. At the end of this phase, interested teachers, computer science teachers and headmasters will have acquired knowledge about GenAI. They will also have been introduced to the lesson module and the website developed.

9.3.2. Horizon 2 | Testing and implementing phase

Explore how Generative AI could be used in education through experimenting and ensure implementation of Generative AI nationwide

Before learning objectives become official and mandatory for education, SLO will first test them in schools to assess the requirements for their effective implementation. This testing phase will start in August 2024 and will last for 18 months. The testing phase is followed by a political decision-making process. The learning objectives are then enshrined in law. This means all schools will have to adhere to these learning objectives. Conscequently, in two years schools will have to implement AI into their curriculum by the law. For this reason, Horizon 2 will be used as a testing and implementing phase. Therefore, the second and final horizon of the roadmap is from August 2024 until August 2026. Over the course of these two years, CLD and SCO Delft will identify effective strategies for integrating GenAI into education through experimentation.

At CLD, Computer science teachers and their students can explore the possibilities of GenAI in education. At the same time, the AI Inspiration Group will conduct collaborative brainstorming sessions and experiments to evaluate applications of GenAI in education. Insights from these parallel initiatives will be shared through workshops and study days, providing valuable guidance and best practices.

SCO Delft can foster collaboration with other educational institutions to promote knowledge exchange, share insights and jointly enhance the website. At the same time, they can share their findings with key stakeholders such as SLO and VO raad. These organisations, in turn, can contact the Ministry of Education to ensure the website evolves into a comprehensive platform accessible to all secondary and primary schools in the Netherlands.

After two years of dedicated brainstorming and experimentation, secondary schools will have a solid understanding and practical experience of GenAI, and educators will have access to essential materials, including the lesson module, successful methods and access to the dedicated website. This collaborative effort aims to provide schools with the necessary information and tools to successfully integrate GenAI into their educational practices.

9.4. Resources

To facilitate the previously mentioned activities, certain resources are essential. Firstly, many GenAI programmes offer both free and paid versions, with the paid versions typically offering superior functionality. To ensure that teachers have access to the optimal version, it's necessary to provide them with subscriptions to a GenAI programme. However, discussions with SCO Delft revealed concerns about purchasing certain subscriptions due to privacy risks. SCO Delft has to carry out a DPIA for the software it buys and pays for. A DPIA examines whether and where major privacy risks can arise in organisations that use personal data, and because GenAI programmes use a lot of people's data, there is little chance that there will be a minor privacy risk. This is why SCO Delft is still cautious about buying a programme.

In an ideal scenario, the government would develop a non-commercial GenAI programme tailored for educational purposes. However, given the complexities involved, it's understandable that both government agencies and institutions face challenges in navigating this terrain. Therefore, if schools currently have a ChatGPT subscription, they pay for it out of their own budget. CLD currently has a ChatGPT subscription for teachers. They are looking into the possibility of getting more subscriptions for teachers.

In addition, the website is currently built using a student subscription in a specific programme. However, once this project has been completed, the student subscription will no longer be valid. Therefore, SCO Delft will take over the financing of the website in the future.

9.5. Conclusion

This chapter outlines a roadmap to facilitate the integration of GenAI into education by the end of August 2026. The process begins with preparing teachers for GenAI through workshops and access to the dedicated website. Teachers and students will then engage in collaborative brainstorming and experimentation to identify successful applications of GenAI in education. The knowledge gained from these efforts will be disseminated through workshops and study days organised by SCO Delft and open to educators from other schools. In addition, SCO Delft will share its findings and provide access to the website with other school authorities and relevant stakeholders, ensuring that all schools in the Netherlands ultimately have the necessary knowledge and resources to integrate GenAI into their educational practices.

It's important to recognise that this roadmap has been developed with the understanding that GenAI will continue to evolve, as it has over the past two years. The field of GenAI is still in its infancy, undergoing rapid growth and advancement. Predicting its trajectory over the next two years presents a significant challenge. For this reason, it's important that both CLD and SCO Delft continue to review the roadmap and assess whether steps are still deemed necessary.

Furthermore, it's important to recognise that not all teachers will be persuaded to use GenAI in their work. Just as some teachers continue to prefer traditional methods such as pen and paper to laptops, there will undoubtedly be those who choose not to integrate GenAI into their teaching methods. It's therefore important that teachers retain the freedom to choose whether or not to implement GenAI.

Image generated by Dall-E 3

10

Conclusion

The previous chapter outlined the implementation steps for GenAI in secondary education, using the website and the lesson module. This concluding chapter presents the main conclusions drawn from this project, followed by a discussion and recommendations.

10.1. Conclusion
10.2. Discussion
10.3. Recommendations

10.1. Conclusion

The overall aim of the project was to explore how secondary school teachers can adapt to ChatGPT in future education. In order to achieve this goal, research was conducted covering both the current context and the future contexts of secondary education. Collaboration with CLD and SCO Delft facilitated access to secondary school teachers and students, providing valuable insights into the subject.

Many teachers are concerned that students may misuse GenAI and lose certain skills. However, much like calculators, GenAI is becoming inevitable for students. With the advent of GenAI, certain skills, such as writing effective emails, may seem less important (World Bank, 2023). This technology will reshape the way we work, underscoring the importance of teaching GenAI skills to the next generation (Taulli, 2023). Without exposure to GenAI, some students may find themselves at a disadvantage to their peers who have mastered the technology, as GenAI allows certain tasks to be completed more quickly. However, it's important not to rely too heavily on GenAI and to maintain a critical perspective on its results. While GenAI offers efficiency, human judgement remains essential. For example, when determining a person's suitability for a job based on their skills and personal characteristics (European Parliament, 2023). GenAI may misinterpret or overlook nuanced aspects of personal characteristics, underscoring the need for human oversight in decision-making processes. Therefore, while students should learn how to use GenAI effectively, they should also be taught how to critique the results. Teachers have a vital role to play in guiding students in this use of GenAI. Despite expressing interest in GenAI, many teachers admitted to a lack of time to explore this emerging technology.

In response to this challenge, two functioning concept prototypes have been developed: ready-made lesson materials and a central repository of information on GenAI. The aim of both prototypes is to provide teachers with GenAI materials for their own use and for use with their students. This minimises the time spent searching for the right tools and information, thus lowering the barrier to entry into GenAI. To support teachers in mastering GenAI, their school management and school board should provide them with materials, dedicated time, and an established channel through which teachers can seek assistance with their questions. Teachers should also be given the freedom to use GenAI in the way they prefer, as autonomy is key for them.

Unfortunately, these two concept prototypes alone may not be enough for teachers to embrace GenAI. Discussions with teachers at CLD revealed that teachers pride themselves in their autonomy and prefer individual approaches to maintain their autonomy. Therefore, integrating new advances into the classroom environment can be challenging, and initial reluctance on the part of teachers is common. Moreover, their busy schedules may cause them to overlook the potential of GenAI amidst day-to-day tasks. Therefore, it's imperative to maintain ongoing discussions about GenAI in schools, where its possibilities are shared and explored. Sharing inspiring ideas and insights from enthusiastic teachers using AI through the school newsletter and social media can effectively engage teachers within and beyond the school community. In addition, using existing teacher time, such as study days and workshops during quieter periods of the school year, can encourage teacher participation without adding to their already demanding schedules. This approach ensures that discussions about GenAI remain relevant and accessible to teachers in the midst of their busy professional lives.

Beyond the school environment, clear government regulation is crucial given the privacy concerns surrounding GenAI programmes. It's important to spread information about these concerns throughout society to ensure that people are aware of the risks involved. Furthermore, the refusal to adopt GenAI could create a divide between AI users and non-users. Additionally, while some individuals may have the financial means to afford paid-for versions of GenAI, others may not (World Economic Forum, 2023a). To address these challenges, the government should develop a non-commercial GenAI programme with strong privacy protections. Some commercial companies have already developed enterprise AI programs that ensure that data collected by the programme is not stored, in order to protect trade secrets (Bueters, 2024). In addition, such a programme could be tailored to the Dutch language to ensure accessibility. This initiative would promote equal access to GenAI resources among society, regardless of their socio-economic background.

In summary, the project aimed to explore the integration of GenAI in secondary education, taking into account both its potential benefits and the concerns of teachers. Working with CLD and SCO Delft, the research provided valuable insights into teachers' perspectives and highlighted the need for support in adopting this technology. While addressing fears of loss of skills and misuse, the project underlined the inevitability of GenAI and the importance of equipping students with the skills to use it effectively and critically evaluate its output. To address teachers' time constraints and reluctance, the project proposed ready-made teaching materials and a centralised information platform. Ongoing discussion, professional development opportunities and government regulation were also identified as essential elements for the integration of GenAI in education, with a focus on privacy and accessibility for all.

10.2. Discussion

10.2.1 One school perspective

This project was carried out in one school. Therefore, the project reflects the needs and perspectives of the teachers in this particular school. As a result, both the lesson module and the website are tailored to CLD. To ensure wider applicability, discussions should be held with teachers from other schools to see if the lesson module and website meet their needs and preferences. This collaborative approach will help to tailor the concepts to appeal to a wider range of schools beyond the scope of this project.

10.2.2. Qualitative research

Throughout the project, in-depth interviews, discussions, surveys and tests were conducted with teachers. In total, nine teachers participated in in-depth interviews, discussions and testing sessions, while approximately 25 teachers provided feedback through surveys. This collaborative effort provided valuable insights and facilitated improvements to the concepts generated. This ensured that the concepts were refined on the basis of continuous feedback from the end users, the teachers.

It's worth noting that the majority of participants in the project were teachers with a particular interest in AI, reflecting the project's focus on this audience. Whilst this targeting was beneficial, future research should aim to engage with a wider range of teachers to better address their different needs.

In addition, both the lesson module and the website are novel rather than redesigns of existing products. As a result, there was no prior evaluation of these concepts at the start of the study. Despite the incorporation of principles from existing products, further testing is recommended to ensure their usability and effectiveness among teachers.

10.2.3. Testing the lesson module

During the testing phase of the lesson module, the ability to gather feedback was dependent on the availability and willingness of teachers to implement the concept with their students. Consequently, there was limited control over the composition and nature of the classes involved in testing the lesson plan. As a result, only older students participated in the testing process. To meet the need for wider applicability, the project relied on the insights of teachers to ensure that the lesson module could be effectively adapted for junior students. However, given the importance of providing junior students with knowledge that will accompany them throughout their academic careers, further testing is essential to validate the suitability and effectiveness of the curriculum for this population.

10.2.4. Testing the website

Due to time constraints and a low response rate to the survey, testing to assess the usability of the website was limited in scope. A total of nine teachers participated in the website evaluation survey, while feedback on the final version of the website was sought from three teachers. In order to improve the usability of the website, it's essential to expand the testing efforts using both qualitative and quantitative methods. This comprehensive approach will provide deeper insights into user preferences, behaviours and needs, ultimately facilitating the refinement and optimisation of the site to better meet the needs of its intended users.

10.2.5. Desirability

Through tests, discussions and surveys, both the lesson module and the website received positive feedback. In particular, a group of 18 teachers expressed a strong interest in accessing both the curriculum and the website for further review or to share with their colleagues. In addition, SCO Delft is considering sharing the website with other school authorities, recognising its potential value beyond their institution. I have also been offered to continue to improve and update the website next year. I have also been invited to give workshops on GenAI at SCO Delft schools in collaboration with the ICT coordinator of CLD. These results underscore a significant level of interest and desirability among CLD, SCO Delft and the primary user group, the teachers.

10.2.6. Desirability

While the lesson module and website are developed and ready for use, the successful integration of GenAI into education will depend on the willingness and commitment of teachers to incorporate these resources into their teaching practice. Recognising this, a roadmap plan was developed to provide CLD and SCO Delft with a clear framework for future action, outlining concrete steps to be taken. The deputy headmaster and the ICT coordinator have both acknowledged the feasibility of the roadmap and have already started to take measures to implement it in the coming year. In addition, SCO Delft has confirmed that the roadmap fits well with their vision for the integration of GenAI in education. However, it's important to emphasise that dedicated time, resources and ongoing discussions about GenAI are crucial to ensure that teachers are equipped to effectively integrate this technology into their educational practice. Ongoing support and collaboration will be necessary to facilitate the successful adoption of GenAI in education.

10.2.7. Viability

The lesson module and website serve as valuable resources for teachers, providing them with convenient access to teaching materials and information about GenAI. The implementation of both the lesson module and the website can seamlessly complement existing school activities. For example, there are already plans to integrate AI into the computer science curriculum. Our lesson module can streamline this process, saving teachers valuable time. In addition, the AI Inspiration Group will receive dedicated time, so teachers will not need to carve out extra time in their schedules to explore GenAI and use the website.
In addition, both Christelijk Lyceum Delft and SCO Delft will benefit from having staff with ICT expertise who will be able to effectively manage and use both the website and the lesson module in the future. This will ensure that the institutions are well equipped to maintain and utilise these resources in the future.

10.3. Recommendations

Collaborations

It's advisable to seek collaboration with other schools and educational institutions as soon as possible. Given the impact of GenAI on society, including education, it's crucial to share knowledge and findings with other educational institutions. This can help avoid duplication and promote efficient use of resources.

Next to that, it's imperative to continue discussions about GenAI within the teaching community and with students. This ongoing dialogue not only allows teachers to learn from each other, but also to gain insight from students' experiences, fostering a more informed and collaborative approach to integrating GenAI into education.

Keeping track of new developments

As GenAI is improving, it will become harder and harder to distinguish AI-made artefacts from human-made artefacts. This could cause one to not be able to distinguish fake news from real news anymore, which is already getting hard for people (Kennisnet, Interview, October 5, 2023). This development will not only have an influence on education but on society as a whole. For example, it was found that humans trust AI-generated faces more than actual human faces (World Economic Forum, 2023b) and copying someone's voice can be used for illegal matters (Brooks et al., 2022). In school, it can be used by bullies as well (Lucas Onderwijs, Interview, October 13, 2023). Therefore, it's crucial that the government, schoolboards, educational institutions and schools keep track of new developments of GenAI.

Keep using GenAI

It was found that students approached the use of GenAI cautiously and saw it primarily as a tool for generating information. However, there are many other valuable applications for GenAI beyond this narrow perspective (Skrabut, 2023). It's therefore imperative that teachers educate their students about these diverse use cases. Encouraging experimentation in the classroom can stimulate discussions about the efficacy and outcomes of using GenAI in different contexts.

In addition, teachers themselves should actively engage with GenAI, either by continuing their existing use or by incorporating it into their professional practice. This proactive approach will ensure that educators keep pace with their students' evolving understanding and use of GenAI, thereby fostering a collaborative and forward-looking learning environment.

Further iteration through testing and user-centred design

In order to further improve both the website and the lesson module, it's recommended that more extensive testing is carried out on a larger scale, involving several teachers and classes at different levels and ages. This diversified testing approach will facilitate continuous improvement of both the lesson module and the website.

Finally, it's crucial to maintain a user-centred design approach by actively involving teachers in the improvement process of both the lesson module and the website. Seeking and incorporating feedback from teachers fosters a sense of ownership and could increase their willingness to use these resources in their teaching practice.

References

A

Abou-Khalil, V., Helou, S., Khalifé, E., Chen, M. A., Majumdar, R., & Ogata, H. (2021). Emergency Online Learning in Low-Resource Settings: Effective Student Engagement Strategies. Education Sciences, 11(1), 24. https://doi.org/10.3390/educsci11010024

Academy_Admin. (2023, September 28). Classroom vs. Online Learning: 4 Advantages and Disadvantages-2023. Streamlyn Academy. https://streamlynacademy.com/blog/classroom-vs-online-learning/#:~:text=In%20a%20physical%20classroom%2C%20students%20can%20ask%20questions%20and%20get,emails%2C%20webinars%2C%20and%20forums.

Ackermann, L., Hepach, R., & Mani, N. (2019). Children learn words easier when they are interested in the category to which the word belongs. Developmental Science, 23(3). https://doi.org/10.1111/desc.12915

AG Connect. (2022, July 19). Digitalisering in het onderwijs moet echt versnellen. Retrieved October 11, 2023, from https://www.agconnect.nl/maatschappij/arbeidsmarkt/digitalisering-in-het-onderwijs-moet-echt-versnellen

AI Act: a step closer to the first rules on Artificial Intelligence | News | European Parliament. (2023, November 5). https://www.europarl.europa.eu/news/en/press-room/20230505IPR84904/ai-act-a-step-closer-to-the-first-rules-on-artificial-intelligence

AiNed bestuur en directie. (2022). Voortgangsrapportage 2022 Stichting AiNed Publieksversie (concept). Voortgangsrapportage. https://ained.nl/wp-content/uploads/2023/06/Voortgangsrapportage-2022-AiNed-publieksversie-concept.pdf

Alkaissi, H., & McFarlane, S. I. (2023). Artificial Hallucinations in ChatGPT: Implications in Scientific Writing. Curēus. https://doi.org/10.7759/cureus.35179

Aston. (2023, October 12). Free AI Voice Cloning In 30 Seconds! No Sign-up Required. Speechify. https://speechify.com/voice-cloning/?landing_url=https%3A%2F%2Fspeechify.com%2Fvoice-cloning%2F

B

Baidoo-Anu, D., & Ansah, L. O. (2023). Education in the Era of Generative Artificial Intelligence (AI): Understanding the potential benefits of ChatGPT in promoting teaching and learning. Social Science Research Network. https://doi.org/10.2139/ssrn.4337484

Barth, S. (2023, June 29). Sustainable AI – How environmentally friendly is AI really? Institut Fur Internet Und Gesellshaft. Retrieved October 11, 2023, from https://www.hiig.de/en/sustainable-ai/
Biggs, J., & Tang, C. S. (1999). Teaching for quality learning at university: What the student does. http://ci.nii.ac.jp/ncid/BA86633208

Benlahcene, A., Kaur, A., & Hashim, R. A. (2020). Basic psychological needs satisfaction and student engagement: the importance of novelty satisfaction. Journal of Applied Research in Higher Education, 13(5), 1290–1304. https://doi.org/10.1108/jarhe-06-2020-0157

Bloom, B. S. (Ed.). (1956). Taxonomy of educational objectives: The classification of educational goals. David McKay Company, INC. https://eclass.uoa.gr/modules/document/file.php/PPP242/Benjamin%20S.%20Bloom%20-%20Taxonomy%20of%20Educational%20Objectives%2C%20Handbook%201_%20Cognitive%20Domain-Addison%20Wesley%20Publishing%20Company%20%281956%29.pdf

Brännlund, A., Strandh, M., & Nilsson, K. (2017). Mental-health and educational achievement: the link between poor mental-health and upper secondary school completion and grades. Journal of Mental Health, 26(4), 318–325. https://doi.org/10.1080/09638237.2017.1294739

Brooks, T., G, P., Heatley, J., J, J., Kim, S., M., S., Parks, S., Reardon, M., Rohrbacher, H., Sahin, B., S., S., S., J., T., O., & V., R. (2022). Increasing threat of Deepfake Identities. In Homeland Security. https://www.dhs.gov/sites/default/files/publications/increasing_threats_of_deepfake_identities_0.pdf

Bueters, P. (2024, January 26). SAP waarschuwt voor toenemende ongelijkheid door AI - SAP Nederland Blogs & Nieuws. SAP Nederland Blogs & Nieuws. https://news.sap.com/netherlands/2024/01/sap-waarschuwt-voor-toenemende-ongelijkheid-door-ai/

Burguillo, J. C. (2010). Using game theory and Competition-based Learning to stimulate student motivation and performance. Computers & Education, 55(2), 566–575. https://doi.org/10.1016/j.compedu.2010.02.018

C

Cantador, I., & Conde, J. M. (2010). EFFECTS OF COMPETITION IN EDUCATION: A CASE STUDY IN AN E-LEARNING ENVIRONMENT. Universidad Autónoma De Madrid. https://d1wqtxts1xzle7.cloudfront.net/30796495/elearning10-libre.pdf?1363411281=&response-content-disposition=inline%3B+filename%3DEFFECTS_OF_COMPETITION_IN_EDUCATION_A_CA.pdf&Expires=1708537448&Signature=K7fwS1fjgHhB9HtW09ZJ1ddTgU~eJ4UnfYm9-6ZSBNwCd6P2lEPUapg9QEO4nxReKUFVb2-NTbC1X8D0jAL0OD7AqAkPc5O4c9vxkPwy1Ewxj0UqfI~bzVH9~QQStz-BXpLLczWec1PLSHpznrOizVu3wEj3UWbo7pSBOYueVvkqqBBxlyIdJDziu-21iE7bPHjqz3wkpeq5T6-G1MeUTjqO66GQtQZs0GO2tZp2wwSRtWAK0TpeaHmsSAwR~uRbzhavUSIsX~FESwb9aVBEC9i8WpODJUXyzjluEQlttKz8i~Hlgnc3CzDCe~I~DDNX01xh5q3EzI0VakZUzb2mLQ__&Key-Pair-Id=APKAJLOHF5GGSLRBV4ZA

Cao, L., & Dede, C. (2023). Navigating A World of Generative AI: Suggestions for Educators. The Next Level Lab, Harvard Graduate School of Education. https://nextlevellab.gse.harvard.edu/2023/07/28/navigating-a-world-of-generative-ai-suggestions-for-educators/

Cao, Y., Li, S., Liu, Y., Zhang, Y., Dai, Y., Yu, P. S., & Sun, L. (2023). A Comprehensive Survey of AI-Generated Content (AIGC): A History of Generative AI from GAN to ChatGPT. arXiv (Cornell University). https://doi.org/10.48550/arxiv.2303.04226

Cavdar, R. (2023). Literatuuronderzoek: Het gebruik van sociale media onder jongeren; In hoeverre heeft het gebruik van sociale media negatieve consequenties bij jongeren? Orvium. https://dapp.orvium.io/deposits/63ea41aac35be71f04f7110a/view

Centraal Bureau voor de Statistiek. (2022, May 11). Nederland Europese koploper digitale vaardigheden. Centraal Bureau Voor De Statistiek. https://www.cbs.nl/nl-nl/nieuws/2022/19/nederland-europese-koploper-digitale-vaardigheden

Chiotaki, D., Poulopoulos, V., & Karpouzis, K. (2023). Adaptive game-based learning in education: a systematic review. Frontiers in Computer Science, 5. https://doi.org/10.3389/fcomp.2023.1062350

Chong, L., Zhang, G., Goucher-Lambert, K., Kotovsky, K., & Cagan, J. (2022). Human confidence in artificial intelligence and in themselves: The evolution and impact of confidence on adoption of AI advice. Computers in Human Behavior, 127, 107018. https://doi.org/10.1016/j.chb.2021.107018

Computational thinking. (n.d.). Digit. Retrieved November 11, 2023, from https://www.digitalegeletterdheid.nl/digitale-vaardigheden/computational-thinking/#:~:text=Computational%20thinking%20leert%20leerlingen%20spelenderwijs,en%20een%20oplossend%20denkvermogen%20nodig.

Council of Europe. (n.d.). AI & discrimination. Coe.int. Retrieved October 24, 2023, from https://www.coe.int/en/web/inclusion-and-antidiscrimination/ai-and-discrimination

Cursum. (2022, October 18). Physical Learning vs. Online Learning: Which One is Better? Cursum. https://cursum.com/blog/e-learning/physical-learning-vs-online-learning/#:~:text=While%20physical%20

learning%20typically%20includes,%2C%20writing%2C%20or%20a%20combination.

D

Darwesh, A. M. (2016). Serious Games in Adaptive Learning. Journal of University of Human Development, 2(4), 418–423. https://doi.org/10.21928/juhd.20161225.18

Dasgupta, D., Venugopal, D., & Gupta, K. D. (2023). A Review of Generative AI from Historical Perspectives. TechRxiv. https://doi.org/10.36227/techrxiv.22097942.v1

De Nationale AI-Cursus. (n.d.). De nationale AI-Cursus. https://www.ai-cursus.nl/

Demir, K. A. (2021). Smart education framework. Smart Learning Environments, 8(1). https://doi.org/10.1186/s40561-021-00170-x

Digi-doener! | Nationale AI-cursus Junior 1 | Kunstmatige intelligentie. (2019, December 1). LessonUp. https://www.lessonup.com/nl/lesson/7CxrRs29t5viMKeuy

Digitale vaardigheden zijn van cruciaal belang, maar onderwijs in digitale geletterdheid is vaak gebrekkig en ongelijk. (n.d.). Universiteit Twente. https://www.utwente.nl/nl/centrumdigitaleinclusie/Blog/19-Digitale_Vaardigheden_Onderwijs_Gebrekkig/

Dijck, J. (2020, October 20). Digitalisering van het onderwijs versterkt kansenongelijkheid tussen leerlingen. Universiteit Utrecht. Retrieved October 11, 2023, from https://www.uu.nl/in-de-media/digitalisering-van-het-onderwijs-versterkt-kansenongelijkheid-tussen-leerlingen

Drugaş, M. (2022). SCREENAGERS OR “SCREAMAGERS”? CURRENT PERSPECTIVES ON GENERATION ALPHA. Psychological Thought, 15(1), 1–11. https://doi.org/10.37708/psyct.v15i1.732

E

European Commission. (2020, September 30). Actieplan voor digitaal onderwijs (2021–2027). European Education Area. Retrieved October 9, 2023, from https://education.ec.europa.eu/nl/focus-topics/digital-education/action-plan

European Parliament. (2020). The ethics of artificial intelligence: Issues and initiatives. Panel for the Future of Science and Technology. https://www.europarl.europa.eu/RegData/etudes/STUD/2020/634452/EPRS_STU(2020)634452_EN.pdf

European Parliament. (2023, August 6). EU AI Act: first regulation on artificial intelligence | News | European Parliament. https://www.europarl.europa.eu/news/en/headlines/society/20230601STO93804/eu-ai-act-first-regulation-on-artificial-intelligence

European Union. (n.d.). Test your digital skills!: Take this test to learn more about your digital profile. Retrieved April 8, 2024, from https://europa.eu/europass/digitalskills/screen/home

Europian Parliament. (2020, October 20). Parliament leads the way on first set of EU rules for Artificial Intelligence | News | European Parliament. Retrieved October 14, 2023, from https://www.europarl.europa.eu/news/en/press-room/20201016IPR89544/parliament-leads-the-way-on-first-set-of-eu-rules-for-artificial-intelligence

G

Gherheș, V. (2018). Why are we afraid of artificial intelligence (AI)? European Review of Applied Sociology, 11(17), 6–15. https://doi.org/10.1515/eras-2018-0006

Godbole, P. (2017). Why do People Resist Change? In Springer eBooks. https://doi.org/10.1007/978-3-319-56224-7_11

Gooreddooder. (2020, January 24). Modern responsive design. Ux ui website. Landing page wireframe design for business. One page website layout template. Dreamstime. https://www.dreamstime.com/modern-responsive-design-ux-ui-website-landing-page-wireframe-design-business-one-page-website-layout-template-landing-page-image170233461

Greenberg, J., & Baron, R. A. (2017). Behavior in Organizations. iBusiness. https://www.scirp.org/reference/referencespapers?referenceid=2106152

Guilford, J. P. (1961). Three faces of intellect. In Appleton-Century-Crofts eBooks (pp. 756–774). https://doi.org/10.1037/11491-066

Gynzy. (n.d.). Gynzy | Interactief lesgeven en adaptief leren. Retrieved October 9, 2023, from https://www.gynzy.com/nl-nl

H

Heijne, K., & Van Der Meer, H. (2019). Road map for creative problem solving techniques: organizing and facilitating group sessions.

Hekkert, P., & Van Dijk, M. (2011). Vision in Design: A Guidebook for Innovators. BIS Publishers.
Helms-Lorenz, M., Van Der Pers, M., Maulana, R., Van Der Lans, R., Moorer, P., & Flens, P. (2019). Opschaling van inductie en het pedagogisch-didactisch handelen van beginnende docenten in het voortgezet onderwijs. University of Groningen, 96, 40–62. https://core.ac.uk/download/pdf/232524338.pdf

Hines, K. (2023, June 5). History Of ChatGPT: A Timeline Of The Meteoric Rise Of Generative AI Chatbots. Search Engine Journal. https://www.searchenginejournal.com/history-of-chatgpt-timeline/488370/#close

I

International Women’s Day. (n.d.). Gender and AI: Addressing bias in artificial intelligence. https://www.internationalwomensday.com/Missions/14458/Gender-and-AI-Addressing-bias-in-artificial-intelligence

L

Jain, D. (2013, November 25). Adaptability towards Digital Technology - A Study of Generation I. https://papers.ssrn.com/sol3/papers.cfm?abstract_id=2427619

Janati, S. E., Maach, A., & Ghanami, D. E. (2018). SMART Education Framework for Adaptation Content Presentation. Procedia Computer Science, 127, 436–443. https://doi.org/10.1016/j.procs.2018.01.141

Juma, C. (2016). Innovation and its enemies (1st ed.). Oxford University Press. https://books.google.nl/books?hl=nl&lr=&id=QZdHDAAAQBAJ&oi=fnd&pg=PP1&dq=Why+do+people+resist+technological+change%3F&ots=9PGjyoLcMD&sig=smjOznO5qhgOIMso-2HmqdWFJXk&redir_esc=y#v=onepage&q=Why%20do%20people%20resist%20technological%20change%3F&f=false

K

Khaddari, R. (2023, July 12). Amsterdams onderwijs in de knel na wegvallen coronasteungeld: ‘We snakken naar structurele middelen.’ Het Parool. Retrieved October 11, 2023, from https://www.parool.nl/amsterdam/amsterdams-onderwijs-in-de-knel-na-wegvallen-coronasteungeld-we-snakken-naar-structurele-middelen~bfb421b02/

Khan Academy. (n.d.). KhanMigo Education AI Guide | Khan Academy. Retrieved July 7, 2023, from https://www.khanacademy.org/khan-labs

Kieslich, K., Lünich, M., & Marcinkowski, F. (2021). The threats of Artificial Intelligence Scale (TAI). International Journal of Social Robotics, 13(7), 1563–1577. https://doi.org/10.1007/s12369-020-00734-w

KNAW. (2013). Digitale geletterdheid in het voortgezet onderwijs. Retrieved October 21, 2023, from https://www.knaw.nl/publicaties/digitale-geletterdheid-het-voortgezet-onderwijs

Koomen, H. M. Y. (2013, November 28). Leerling én leraar profiteren van goede onderlinge relatie | NRO. NRO. Retrieved November 7, 2023, from https://www.nro.nl/onderzoeksprojecten/leerling-en-leraar-profiteren-van-goede-onderlinge-relatie

Kumar, N. (2023, July 19). The latest generative AI in fashion news (2023). LinkedIn. Retrieved October 11, 2023, from

https://www.linkedin.com/pulse/latest-generative-ai-fashion-news-2023-neeraj-kumar/

L

Liang, Y., & Lee, S. A. (2017). Fear of Autonomous Robots and Artificial Intelligence: Evidence from National Representative Data with Probability Sampling. International Journal of Social Robotics, 9(3), 379–384. https://doi.org/10.1007/s12369-017-0401-3
Lily, A. E. A., Ismail, A. F., Abunasser, F., Al-Lami, F., & Abdullatif, A. K. A. (2023). ChatGPT and the rise of semi-humans. Humanities and Social Sciences Communications, 10(1). https://doi.org/10.1057/s41599-023-02154-3

Lorenz, A. (n.d.). What is trust in technology? Conceptual bases, common pitfalls and the contribution of trust research. Trust & Technology Initiative. https://www.trusttech.cam.ac.uk/perspectives/technology-humanity-society-democracy/what-trust-technology-conceptual-bases-common#:~:text=Consequently%2C%20when%20we%20talk%20about,the%20misplaced%20trust%20of%20users.

Lynch, M. (2020, February 21). In school together, but not learning at the same rate - the Edvocate. The Edvocate. Retrieved October 18, 2023, from https://www.theedadvocate.org/in-school-together-but-not-learning-at-the-same-rate/

M

Malikovna, K. R., Mirsharapovna, S. Z., Shadjalilovna, S. M., & Kakhramonovich, A. A. (2022). Types of Interactive Methods in Teaching English to Students. Texas Journal ofMultidisciplinary Studies, 14(2770–0003). https://zienjournals.com/index.php/tjm/article/view/2641/2214

Mead, S. (n.d.). Differentiated Learning: Why “One size fits all” doesn’t work in education. Retrieved November 7, 2023, from https://www.whitbyschool.org/passionforlearning/differentiated-learning-why-one-size-fits-all-doesnt-work-in-education

Meyer, D. (2023, October 11). The misunderstanding about education that cost Mark Zuckerberg $100 million. Mathworlds. https://danmeyer.substack.com/p/the-misunderstanding-about-education

Ministerie van Algemene Zaken. (2021). Opgave AI. De nieuwe systeemtechnologie. In Rapport | WRR (No. 105). Retrieved October 18, 2023, from https://www.wrr.nl/adviesprojecten/artificiele-intelligentie/documenten/rapporten/2021/11/11/opgave-ai-de-nieuwe-systeemtechnologie

Ministerie van Justitie en Veiligheid. (2022, November 30). Digitale kloof en mensenrechten. College Voor De Rechten Van De Mens. Retrieved October 20, 2023, from https://www.mensenrechten.nl/actueel/toegelicht/toegelicht/2022/digitale-kloof-en-mensenrechten

Ministerie van Onderwijs, Cultuur en Wetenschap. (2022, November 9). Behoefte aan leraren. Voortgezet Onderwijs | OCW in Cijfers. Retrieved October 8, 2023, from https://www.ocwincijfers.nl/sectoren/voortgezet-onderwijs/personeel/arbeidsmarkt-en-personeelstekorten-vo/toekomstige-situatie/behoefte-aan-leraren
Ministerie van Onderwijs, Cultuur en Wetenschap. (2023a, January 12). Inzet van intelligente technologie. Advies | Onderwijsraad. https://www.onderwijsraad.nl/publicaties/adviezen/2022/09/28/inzet-van-intelligente-technologie

Ministerie van Onderwijs, Cultuur en Wetenschap. (2023b, April 18). Leeftijd van personeel in het voortgezet onderwijs. Voortgezet Onderwijs | OCW in Cijfers. Retrieved October 11, 2023, from https://www.ocwincijfers.nl/sectoren/voortgezet-onderwijs/personeel/leeftijd-van-personeel-in-het-voortgezet-onderwijs

Ministerie van Onderwijs, Cultuur en Wetenschap. (2023c, December 4). Home - Nationaal Programma Onderwijs. https://www.nponderwijs.nl/

Mollick, E. (2022, December 14). ChatGPT is a tipping point for AI. Harvard Business Review. https://hbr.org/2022/12/chatgpt-is-a-tipping-point-for-ai

Mollick, E., & Mollick, L. (2023). Assigning AI: Seven Approaches for Students, with Prompts. Social Science Research Network. https://doi.org/10.2139/ssrn.4475995

Muzammil, M., Sutawijaya, A., & Harsasi, M. (2020). INVESTIGATING STUDENT SATISFACTION IN ONLINE LEARNING: THE ROLE OF STUDENT INTERACTION AND ENGAGEMENT IN DISTANCE LEARNING UNIVERSITY. The Turkish Online Journal of Distance Education, 21(Special Issue-IODL), 88–96. https://doi.org/10.17718/tojde.770928

N

Naberink, T., & Mutsaarts, M. (2024, March 13). AI voor Docenten | Uw bron voor AI in het onderwijs. AI Voor Docenten - Dé Bron Voor AI-onderwijstools En -technieken. https://aivoordocenten.com/

Nahardiya, G., Markus, A., Bennet, R., & Shamay-Tsoory, S. G. (2022). The benefits of learning movement sequences in social interactions. Frontiers in Psychology, 13. https://doi.org/10.3389/fpsyg.2022.901900

Nationaal Regieorgaan Onderwijsonderzoek. (2019, May). Wat is het effect van het behalen van veel hoge of veel lage cijfers op de sociaal-emotionele ontwikkeling van leerlingen? | Kennisrotonde. Kennisrotonde. https://www.kennisrotonde.nl/vraag-en-antwoord/werking-cijfers

Nature. (2023). ChatGPT is a black box: how AI research can break it open. Nature, 619(7971), 671–672. https://doi.org/10.1038/d41586-023-02366-2

Nederlands Jeudginstituut. (2022, June 20). “Herstel relatie tussen leerling en leraar” | Nederlands Jeugdinstituut. Retrieved November 7, 2023, from https://www.nji.nl/nieuws/herstel-relatie-tussen-leerling-en-leraar
Nederlands Jeugdinstituut. (2023a, March 24). Cijfers over mediagebruik. Retrieved December 22, 2023, from https://www.nji.nl/cijfers/mediagebruik#gebruik-van-sociale-media-door-scholieren

Nederlands Jeugdinstituut. (2023b, May 26). Cijfers over pesten: slachtoffers. Retrieved December 31, 2023, from https://www.nji.nl/cijfers/pesten-slachtoffers#:~:text=In%202001%20zei%20ruim%2012,gedaald%20naar%205%2C3%20procent.

Nederlands Jeugdinstituut. (2023c, June 13). Cijfers over welbevinden en mentale gezondheid | Nederlands Jeugdinstituut. Retrieved November 7, 2023, from https://www.nji.nl/cijfers/welbevinden#mentale-problemen-onder-scholieren

Neendoor, S. (2023, October 9). Is Game-Based learning the future of education? Hurix Digital. https://www.hurix.com/is-game-based-learning-the-future-of-education/

NL AI Coalitie. (2021). Nederlandse AI Coalitie blij met steun Nationaal Groeifonds om ambitie te verwezenlijken. Nederlandse AI Coalitie. https://nlaic.com/nieuws/nederlandse-ai-coalitie-blij-met-steun-nationaal-groeifonds-om-ambitie-te-verwezenlijken/

NL AI Coalitie. (2023, October 25). Teach the Teacher - Nederlandse AI coalitie. Nederlandse AI Coalitie. https://nlaic.com/bouwstenen/human-capital/teach-the-teacher/

NOLAI | Nationaal Onderwijslab AI. (n.d.). https://www.ru.nl/nolai

NOS. (2023a, March 31). Nederland tegen strengere regels ChatGPT, schoolopdracht beter met “pen en papier.” NOS. https://nos.nl/artikel/2469655-nederland-tegen-strengere-regels-chatgpt-schoolopdracht-beter-met-pen-en-papier

NOS. (2023b, April 19). Een chatbot die in het echt wil afspreken? Ook Snapchat vindt het wat ver gaan. NOS. https://nos.nl/artikel/2472026-een-chatbot-die-in-het-echt-wil-afspreken-ook-snapchat-vindt-het-wat-ver-gaan

O

Onderzoek naar corona en onderwijs. (2023, August 4). Nederlands Jeugdinstituut. Retrieved November 7, 2023, from https://

www.nji.nl/coronavirus/onderzoek-naar-corona-en-onderwijs

OpenAI. (2022, November 30). Introducing ChatGPT. https://openai.com/index/chatgpt

OpenAI. (2023, April 25). New ways to manage your data in ChatGPT. OpenAI.com. Retrieved October 25, 2023, from https://openai.com/blog/new-ways-to-manage-your-data-in-chatgpt
Oppenlaender, J., Linder, R., & Silvennoinen, J. (2023). Prompting AI Art: An Investigation into the Creative Skill of Prompt Engineering. arXiv (Cornell University). https://doi.org/10.48550/arxiv.2303.13534

Özgür, T. (2023). Active learning improves academic achievement and learning retention in K-12 settings: A meta-analysis. Journal on School Educational Technology, 18(3), 1. https://doi.org/10.26634/jsch.18.3.19288

P

Pang, K. F. (2023, May 14). Why Does ChatGPT Feel So Human? Psychology Today. Retrieved October 25, 2023, from https://www.psychologytoday.com/us/blog/consciousness-and-beyond/202305/why-does-chatgpt-feel-so-human

Perryman, J., & Calvert, G. (2019). WHAT MOTIVATES PEOPLE TO TEACH, AND WHY DO THEY LEAVE? ACCOUNTABILITY, PERFORMATIVITY AND TEACHER RETENTION. British Journal of Educational Studies, 68(1), 3–23. https://doi.org/10.1080/00071005.2019.1589417

Piersma, N., & Wiggers, P. (2023). Impact van intelligente technologie in het onderwijs. Amsterdam University of Applied Sciences. https://openresearch.amsterdam/image/2023/3/21/intelligente_technologie_in_het_onderwijs_2.pdf

Q

Quekel, S. (2023, May 3). Onderling wantrouwen ouders en docenten over AI: 'We moeten het zélf maar uitzoeken.' AD. Retrieved November 6, 2023, from https://www.ad.nl/tech/onderling-wantrouwen-ouders-en-docenten-over-ai-we-moeten-het-zelf-maar-uitzoeken~a498b151/

R

Rajnerowicz, K. (2023, July 6). Human vs AI Test: Can We Tell the Difference Anymore? Tidio. https://www.tidio.com/blog/ai-test/#quiz

Rincón-Saavedra, Y., Garzón-Morales, E., & Cortés-Rico, L. (2019). Learning through designing, designing through doing. ACM Digital Library. https://doi.org/10.1145/3358961.3358983

RTL Nieuws. (2023, September 14). Privacywaakhond: AI-chatbots risicovol voor kinderen. Retrieved October 11, 2023, from https://www.rtlnieuws.nl/tech/artikel/5407628/ai-chatbot-kinderen-risico-autoriteit-persoonsgegevens

S

Samplonius, L. (2022, May 13). Scholen experimenteren met andere toetsen: minder cijfers, meer feedback. RTL Nieuws. Retrieved November 7, 2023, from https://www.rtlnieuws.nl/nieuws/nederland/artikel/5308157/onderwijs-nieuw-lesmethode-geen-cijfers-meer-formatief-handelen

Sanders, E., & Stappers, P. J. (2019). Convivial Toolbox [Paperback]. BIS Publishers.

Sanders, P. B. A. (2023). Genderonderwijs en Seksuele Diversiteit bij Onderzoek & Ontwerpen in het Voortgezet Onderwijs: Een les in gender en seksuele diversiteit op school - University of Twente Student Theses. University of Twente. https://essay.utwente.nl/94045/

Schellevis, J., & Moerland, S. (2023, January 16). ChatGPT glipt langs docenten: "Ik gebruik het om snel huiswerk te maken." NOS. https://nos.nl/artikel/2460020-chatgpt-glipt-langs-docenten-ik-gebruik-het-om-snel-huiswerk-te-maken

Schildkamp, K. (2023, September 29). Slimmer onderwijs met AI - Npuls. Npuls. https://npuls.nl/actueel/npuls-presenteert-het-magazine-slimmer-onderwijs-met-ai/

Sherzod, N., & Leonodovna, M. N. (2023). FOSTERING COMMUNICATIVE CULTURE IN PHYSICAL EDUCATION: ENHANCING LEARNING AND SOCIAL INTERACTION. International Journal of Advance Scientific Research, 03(06), 31–36. https://doi.org/10.37547/ijasr-03-06-06

Simonse, L. (2017). Design Roadmapping (1st ed.). Paagman.

SITNFlash. (2020, April 23). The History of Artificial intelligence - Science in the News. Science in the News. https://sitn.hms.harvard.edu/flash/2017/history-artificial-intelligence/

Skrabut, S. (2023). 80 Ways to use ChatGPT in the Classroom. Stan Skrabut.

SLO. (2024). Conceptkerndoelen burgerschap en digitale geletterdheid. SLO, 36. https://slo-kerndoelen.files.svdcdn.com/production/uploads/assets/updates/DEF_kerndoelenboekje_BU_DG.pdf?dm=1709640714

Smeets, K., Van Der Ven, S., Peterse, E., & Bakx, A. (2022). Welke verwachtingen heb jij over jouw kind of leerling? 248media.nl. https://www.point013.nl/wp-content/uploads/2022/09/Welke-verwachtingen-heb-jij-over-jouw-kind-of-leerling.pdf

Snappet Nederland B.V. (2023, June 26). Snappet | Teaching = awesome. Snappet. Retrieved October 9, 2023, from https://snappet.nl/

Sollie, J., Bakx, A. W. E. A., & Van Der Ven, S. H. G. (2023). Een positief gevoel van uniciteit: een onderzoek naar het verband tussen identiteit en sociaal schoolwelzijn. Radboud University. https://www.point013.nl/wp-content/uploads/2023/09/Gifted@248_-Zomer-2023_JanetAnouke-Sanne.pdf

Stichting Kennisnet. (2023a, July 24). Verantwoord inzetten van artificial intelligence - Kennisnet. Kennisnet. https://www.kennisnet.nl/publicaties/verantwoord-inzetten-van-artificial-intelligence/

Stichting Kennisnet. (2023b, September 28). ChatGPT bij toetsen en examens: maak nu heldere afspraken - Kennisnet. Kennisnet. https://www.kennisnet.nl/artikel/21095/chatgpt-bij-toetsen-en-examens-maak-nu-heldere-afspraken/

Stichting Kennisnet. (2023c, September 29). Drie ambities van Kennisnet voor toekomstgericht onderwijs - Kennisnet. Kennisnet. https://www.kennisnet.nl/artikel/21185/drie-ambities-van-kennisnet-voor-toekomstgericht-onderwijs/

Stichting Kennisnet. (2023d, October 6). "AI blijft, evolueert en zet het onderwijs nog verder op zijn kop" - Kennisnet. Kennisnet. https://www.kennisnet.nl/artikel/20165/ai-blijft-evolueert-en-zet-het-onderwijs-nog-verder-op-zijn-kop/

Stupans, I., Scutter, S., & Pearce, K. (2010). Facilitating Student Learning: Engagement in novel learning opportunities. Innovative Higher Education, 35(5), 359–366. https://doi.org/10.1007/s10755-010-9148-6

Swedberg, R. (2020). Exploratory research. In Cambridge University Press eBooks (pp. 17–41). https://doi.org/10.1017/9781108762519.002

T

Taulli, T. (2023). Introduction to Generative AI. In Apress eBooks (pp. 1–20). https://doi.org/10.1007/978-1-4842-9367-6_1

Teacher Tapp. (2023, March 9). Onderwijsangsten – Teacher Tapp Nederland. Retrieved October 23, 2023, from https://nl.teachertapp.com/onderwijsangsten/

The European Commission's HIGH-LEVEL EXPERT GROUP ON ARTIFICIAL INTELLIGENCE. (2018). A DEFINITION OF AI: MAIN CAPABILITIES AND SCIENTIFIC DISCIPLINES. European Commission. https://ec.europa.eu/futurium/en/system/files/ged/ai_hleg_definition_of_ai_18_december_1.pdf

Timotheou, S., Miliou, O., Dimitriadis, Y., Sobrino, S. V., Giannoutsou, N., Cachia, R., Martínez-Monés, A., & Ioannou, A.

(2022). Impacts of digital technologies on education and factors influencing schools' digital capacity and transformation: A literature review. Education and Information Technologies, 28(6), 6695–6726. https://doi.org/10.1007/s10639-022-11431-8

U

Universiteit Utrecht. (n.d.). Generatieve AI. Retrieved October 15, 2023, from https://www.uu.nl/onderwijs/onderwijs-aan-de-uu/onderwijs-geven/generatieve-ai#:~:text=Generatieve%20AI%20(GenAI)%20is%20een,van%20grote%20hoeveelheden%20bestaande%20data

Universiteit van Amsterdam. (2023, May 2). Automatisering nauwelijks toegenomen, terwijl krapte op Nederlandse arbeidsmarkt aanhoudt. Universiteit Van Amsterdam. https://www.uva.nl/content/nieuws/persberichten/2023/05/automatisering-nauwelijks-toegenomen-terwijl-krapte-op-nederlandse-arbeidsmarkt-aanhoudt.html?cb

University of Rochester medical center. (n.d.). Self-Determination Theory of Motivation: Center for Community Health & Prevention. Retrieved November 29, 2023, from https://www.urmc.rochester.edu/community-health/patient-care/self-determination-theory.aspx

Using constructive alignment in your education | Radboud University. (n.d.). https://www.ru.nl/en/staff/lecturers/designing-education/designing-courses/integrating-learning-objectives

V

Van De Werfhorst, H., Kessenich, E., & Geven, S. (2023). The Digital Divide in Online Education. Inequality in Digital Preparedness of Students and Schools before the Start of the COVID-19 Pandemic. SocArXiv. https://doi.org/10.31235/osf.io/58d6p

Van Den Eijnden, R. J. J. M., Geurts, S. M., & Koning, I. M. (2019). Is het gebruik van games en sociale media gerelateerd aan het psychosociaal en school functioneren van jongeren? ResearchGate. https://doi.org/10.1007/s12453-019-00204-9

Van Der Want, A. C. (2015, November 16). Relatie met leerling van invloed op welzijn docent | NRO. NRO. Retrieved November 7, 2023, from https://www.nro.nl/nieuws/relatie-met-leerling-van-invloed-op-welzijn-docent

Van Kammen, R. (2022, December 31). Wat is het effect van docentondersteuning en self-efficacy bij het streven naar self-concordant goals in het voortgezet onderwijs? Open Universiteit Research Portal. Retrieved November 7, 2023, from https://research.ou.nl/en/studentTheses/wat-is-het-effect-van-docentondersteuning-en-self-efficacy-bij-he

Van Wynsberghe, A. (2021). Sustainable AI: AI for sustainability and the sustainability of AI. AI And Ethics, 1(3), 213–218. https://doi.org/10.1007/s43681-021-00043-6

Veiligheidsmonitor 2021-2022 - School en veiligheid. (2023, July 27). School En Veiligheid. https://www.schoolenveiligheid.nl/kennisbank/veiligheidsmonitor-2021-2022/#:~:text=In%20het%20primair%20onderwijs%20is,%2C%20tegenover%20lhbt%3A%2018%25).

Veltman, K. H., De Weerd, H., & Verbrugge, R. (2018). Training the use of theory of mind using artificial agents. Journal on Multimodal User Interfaces, 13(1), 3–18. https://doi.org/10.1007/s12193-018-0287-x

Veranderkracht tijdens én na corona: een digitale sprong in het diepe. (2021, June 7). PO-Raad. https://www.poraad.nl/schoolontwikkeling/digitalisering/professionele-inzet-ict/veranderkracht-tijdens-en-na-corona-een

VO Raad. (2023). Het verhaal achter de cijfers: Sectorrapportage 2023. VO Raad. https://sectorrapportage.vo-raad.nl/wp-content/uploads/2023/11/Sectorrapportage_VO_raad_2023_29Nov_2023.pdf

W

Weitzman, T. (2023, March 28). GPT-4 Released: What It Means For The Future Of Your Business. Forbes. https://www.forbes.com/sites/forbesbusinesscouncil/2023/03/28/gpt-4-released-what-it-means-for-the-future-of-your-business/

World Bank. (2023, July 7). Open Knowledge Repository. https://openknowledge.worldbank.org/handle/10986/39959

World Economic Forum. (2023a, April 30). The Future of Jobs Report 2023. Retrieved October 20, 2023, from https://www.weforum.org/publications/the-future-of-jobs-report-2023/

World Economic Forum. (2023b, October 6). People trust AI fake faces more than real ones, according to a new study. Retrieved October 11, 2023, from https://www.weforum.org/agenda/2022/03/ai-fake-faces-more-trustworthy/

Y

Yannier, N., Hudson, S. E., Koedinger, K. R., Hirsh-Pasek, K., Golinkoff, R. M., Munakata, Y., Doebel, S., Schwartz, D. L., Deslauriers, L., McCarty, L. S., Callaghan, K., Theobald, E. J., Freeman, S., Cooper, K. M., & Brownell, S. E. (2021). Active learning: "Hands-on" meets "minds-on." Science, 374(6563), 26–30. https://doi.org/10.1126/science.abj9957

Young Reporters. (2023, December 12). Jongeren en AI: hoe maak jij ze wegwijs? Check onze (les)tips en tools uit onze jongerenspecial! Codename Future. Retrieved January 26, 2024, from https://www.codenamefuture.nl/jongeren-en-ai-hoe-maak-jij-ze-wegwijs-check-onze-lestips-en-tools-uit-onze-jongerenspecial/

Z

Zimmerman, J. (2006). Why Some Teachers Resist Changeand What Principals Can Do About It. SageJournals. https://doi.org/10.1177/0192636506291521open_in_new

Zimmerman, J. A. (2006). Why some teachers resist change and what principals can do about it. NASSP Bulletin, 90(3), 238–249. https://doi.org/10.1177/0192636506291521

Appendix

Appendix A - Research Setup Interviews Stakeholders

A.1. Research goal

The purpose of interviewing stakeholders in secondary education in the Netherlands was to gain insight into the current landscape surrounding ChatGPT and its integration into educational practice. These interviews aim to shed light on the extent to which the educational sector is adapting to the presence of ChatGPT. Understanding the perspectives and actions of stakeholders within secondary education helps to shape the current context of secondary education.

A.2. Research question

Main research question for understanding the current context:

How is secondary education adapting to and utilizing ChatGPT?

Sub-research questions:

- How are educational institutions formulating new school rules and policies in response to the presence of ChatGPT?
- To what extent have educational institutions changed their teaching methods and assessment practices to accommodate the use of ChatGPT?
- What considerations are being made about the appropriate level of control to be exercised over AI technologies such as ChatGPT in educational settings?
- To what extent do educational institutions believe that AI should be integrated into education?
- What are the risks and opportunities of AI?

A.3. Data collection

The above questions were answered through interviews with stakeholders and through conducting desk research. In this Appendix, the setup for conducting interview with stakeholders will be discussed.

Stakeholder number	Profession	Employer
1	Head of AI at educational publisher	Thiememeulenhoff
2	Head of AI at educational publisher	Noordhoff
3	Technological Innovation team	Kennisnet
4	Chair of the school board	SCO Delft
5	Chair of the school board	Lucas Onderwijs
6	Secondary school teacher & employee NOLAI	NOLAI
7	Secondary school teacher & ChatGPT fan	Etty Hillesum Lyceum
8	Secondary school teacher & ChatGPT fan	Maerlant College Brielle
9	Professor Social sciences (Education)	University of Twente

Table A.1: Overview of stakeholders interviewed

A.4. Location & set-up

Stakeholder interviews were held online through a Teams meeting. The Teams meeting was recorded and transcribed. These transcriptions were used to cluster relevant information. The transcriptions and recordings were destroyed after drawing insights.

A.5. Stakeholder recruitment

The identification of stakeholders in secondary education was carried out by SCO Delft. Based on their list of stakeholders, requests were made to interview them. A wide range of domain stakeholders were interviewed to gain a comprehensive understanding of the integration of ChatGPT in education, which is shown in Table A.1.

A.6. Method

Semi-structured interviews were held with stakeholders. Below, all questions asked to stakeholders are listed.

Pre-interview

Sent consent form
Sign consent form
Record meeting
Introduction of myself
Introduction of them

Questions

1. What do you see happening around the topic of ChatGPT? What stands out to you?
2. Do you see activity in high schools related to ChatGPT (from principals, teachers, schools, etc.)?
3. What do you think needs to happen concerning ChatGPT?
4. Have you set any specific goals, plans, or actions related to ChatGPT?
5. Are you already using AI in products, internally, etc.?
6. How should high schools respond to this development?
7. Do you see opportunities emerging regarding this topic in high schools?
8. Are there any risks associated with ChatGPT in high schools?
9. What role should high school teachers take on? Or how does the role of the high school teacher change?
10. What role do you think ChatGPT should play in education?
11. What role should high school teachers take on? Or how does the role of the high school teacher change?
12. How much control should ChatGPT take in education?

A.7. Limitations

Since SCO Delft conducted the identification of stakeholders in secondary education, it's likely that there is a common perspective among these stakeholders. Despite reaching out to the stakeholders directly, there may still be a tendency for this common perspective to influence the interviews. In addition, the interview outcomes may have been influenced by my own bias, as I was the sole judge of the interview results.

Appendix B - Risks and opportunities

B.1. Risks of AI

B.1.1. Confiding in ChatGPT as a friend

There is a chance that some students will start perceiving ChatGPT as a virtual friend. Snapchat recently released 'My AI' in collaboration with ChatGPT on their Snapchat app (NOS, 2023). It introduces itself as your virtual friend, see Figure A.1.

This is causing commotion as a lot of young people use this app and people are worried adolescents will confide too much in this 'virtual friend'. Some people feel like talking to a human when talking to ChatGPT (Lily et al., 2023) because it is mimicked to interact with you in a humanlike manner (Pang, 2023). Therefore, people can start using Generative AI like MyAI and ChatGPT to ask personal questions. For example, what they should do when they feel lonely, are in unsafe situations, or have questions about sex (Piersma & Wiggers, 2023). Instead of asking these questions to caregivers, teachers, parents or friends, they reach out to a virtual machine. This can cause tricky situations.

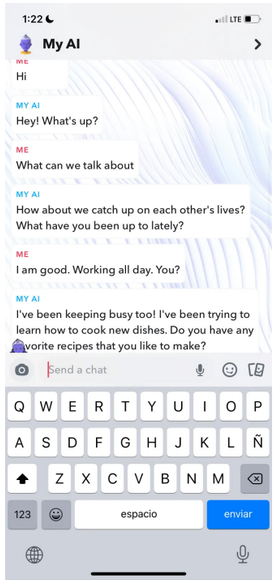


Figure A.1: My AI introducing itself as a virtual friend

B.1.2. Losing the ability to think for yourself

Last but not least, there is a fear that people will lose the ability to think for themselves. Students can gullibly copy anything ChatGPT generates without checking this. They might stop thinking for themselves (Ministerie van Onderwijs, Cultuur en Wetenschap, 2023). Students and teachers can start seeing the technology as a given, which leads to believing anything it generates. "We're already seeing people are forgetting how to read maps, they're forgetting other skills - John Havens" (European Parliament, 2020). This is tricky because ChatGPT does make mistakes and it contains a bias. For this reason, students should always be critical of the outcome. Additionally, trusting AI solely could influence important decisions in education. For example, when deciding what level a student should follow (Lucas Onderwijs, Interview, October 13, 2023). Therefore, teachers and students need to be reminded to not solely rely on technical intelligence.

B.2. Opportunities of AI for education

Through desk research and talking to early adopter teachers and experts in the field, it was discovered that AI could become of great help to teachers in several different areas of their work. Below the opportunities of AI in education have been summarised. Important to note is that more opportunities might arise during the period of this project, as ChatGPT is new and more applications of it will be developed.

B.2.1. A teacher's assistant

With AI, teachers could take logistical matters off the hands of teachers. ChatGPT can be trained to grade student essays, write original emails to parents, etc. This provides teachers with more time to focus on other aspects of teaching (Baidoo-Anu, 2023). Both 'Kennisnet' and the 'Onderwijsraad' believe that in a supporting role, AI can take away a lot of the administrative work for teachers.

B.2.2. Spark creativity

Next to handling logistical matters, AI can also provide inspiration for lessons when they want to do something different. It can provide teaching methods and even make a whole plan for specific topics they want their students to learn. In interviews with two teachers, they mentioned that it also allows teachers to include current events in their classes. For example, they can pick a news article and ask ChatGPT to create questions related to the article. GenAI allows teachers to be more creative with their classes without spending too much time thinking about this.

B.2.3. Personalised learning

Teachers who work at secondary schools have multiple classes which makes it difficult for them to provide specific feedback for each student. AI can be a solution for this. Several companies are making dashboards specifically to be used in education. The progress of each student is tracked by gathering data from digital assignments they make. The assignments are adjusted to the level of each student. The teachers can check the dashboard to see the progress of students and of the whole class (Snappet Nederland B.V., 2023), (Gynzy, n.d.). The AI used for these dashboards is mainly focused on gathering the data and creating an overview of results for the teachers. So it does not immediately refer to Generative AI. However, some of these companies are now experimenting with how they can include GenAI in their products. ChatGPT can be used to provide personalized tutoring and feedback to students based on their individual learning needs and progress (Baidoo-Anu, 2023). This could be implemented in these dashboards. However, ChatGPT can also be used on its own by using the right prompts. This creates a lower threshold for schools to start using ChatGPT for personalised learning.

B.2.4. A study buddy

Next to creating dashboards and personalized tutoring for students, some companies are even taking it a step further. Multiple companies are creating virtual mentors/tutors/study buddies for students to get more personal feedback (Khan Academy, n.d.). With the help of GenAI, new assignments can be created on the spot for each student individually. They can even tap into what the students like at that moment. For example, a student who is into racing could do an assignment on the speed of a Formula 1 car (Kennisnet, Interview, October 5, 2023).

Appendix C - Qualitative interviews with students

C.1. Research goal

To design effectively for our user group, it is essential to understand the context in which users would engage with the design. Students play an important role in the teacher's context. Therefore, it is crucial to explore students' perspectives and experiences with ChatGPT. For this reason, interviews were conducted with students to gain insight into their understanding of ChatGPT and the extent to which students use it.

C.2. Research question

- What is the current use and knowledge of ChatGPT by students?
- What is the student's view on ChatGPT?

C.3. Data collection

C.3.1. Guerrilla Interviews:

Guerrilla interviews were used to answer the research questions. Students were invited to share their thoughts voluntarily to ensure their comfort and willingness to participate. First, general questions about the school were asked to ensure that students felt comforTable sharing their knowledge and experiences on ChatGPT. Students were then asked questions about ChatGPT to explore their understanding and use of the tool.

C.3.2. Raise your hand if:

Before one-to-one interviews, a quick assessment of students' awareness and use of ChatGPT was conducted using a 'raise your hand if' approach. Three short questions were posed to the whole class and students were asked to raise their hands if they:

1. Had heard of ChatGPT.
2. Had used ChatGPT.
3. Had used ChatGPT specifically for school purposes.

This approach provided an initial indication of students' familiarity and engagement with ChatGPT.

C.4. Location and set-up

Students were interviewed in their classroom in the presence of other students and the teacher. No audio, video or pictures were taken of the students, only notes were taken. The 'raise your hand if' method was done by the designer standing in front of the class. The guerrilla interviews were conducted by sitting next to the students in the classroom.

C.5. Students

The recruitment of students for the project was facilitated by the kind cooperation of one teacher at the school. Table A.2 shows a summary of the age range and level of education of the students involved in this phase of the project.

Characteristics	# of students	# of classes
Grade		
Senior general secondary education	4	2
Pre-university education	3	1
Age		
16-17 years old	4	2
17-18 years old	3	1

Table A.2: Overview of students interviewed and amount of classes that were asked to raise their hands to answer questions

C.6. Method

Script

Introduction of myself to class
Let students know they do not need to talk to me if they do not feel comfortable doing so.
Explain the consent form

I'm going to ask you three questions and you can answer by raising your hand or not.

Raise your hand if:

1. You have heard of ChatGPT.
2. You have used ChatGPT.
3. You have used ChatGPT specifically for school purposes.

Questions
1. What do you know about ChatGPT?
2. Do your friends use ChatGPT?
3. How do you use ChatGPT?
4. Why do you use ChatGPT?
5. For which subjects do you use ChatGPT? Or do you use it for all subjects?
6. When do you use ChatGPT?
7. Where do you use ChatGPT? (during class, at home, during breaks)
8. How often do you use it in a day? Or in a week?
9. Do you feel comfortable disclosing that you use ChatGPT at school?
10. Do you think teachers use ChatGPT? Why or why not?

C.7. Limitations

Our ability to recruit students for interviews depended on the availability of the school. As a result, we had limited control over the students who participated, which meant that only older students participated in the testing process. This led to a biased perspective and level of knowledge about Generative AI.

Appendix D - Qualitative interviews with teachers

D.1. Research goal

In order to design for teachers, it was important to understand them at a deeper level. The aim of this research was to find out what teachers value in their work, how they use ChatGPT and what they think of ChatGPT.

D.2. Research question

- What is the current use and knowledge of ChatGPT by teachers?
- What is the teacher's view on ChatGPT?
- What and why do teachers value in their work?

D.3. Data collection

Semi-structured interviews were used to answer the research questions. First, teachers were presented with a series of questions about their perspectives and experiences with ChatGPT. Teachers were also provided with task cards (Figure A.2) to outline the various tasks involved in their work. Teachers were then asked to arrange these cards on a value sheet (Figure A.3) and finally to explain the placement of the tasks. This process facilitated a deeper understanding of teachers' values in their work.

D.4. Location and set-up

Teachers were interviewed in their professional environment at the Christelijk Lyceum Delft. The majority of the teachers generously gave access to their empty classrooms for the interviews, thus allowing a first-hand observation of their working environment. The interviews were recorded to capture the discussions, while photographs of the task cards and value sheets were taken to document the process and findings.

Figure A.2: Task cards

Figure A.3: Value sheet to map task cards

D.5. Teachers

Teachers were recruited through a survey distributed throughout the school via the newspaper and QR codes strategically placed in the teachers' lounge. Six teachers agreed to take part in this phase of the project.

Characteristics	# of teachers
ChatGPT experience	
Used ChatGPT every week	1
Has used ChatGPT 1-3 times	2
No ChatGPT experience	3
Subject they teach	
German	1
Biology	1
Science	2
English	1
Dutch	1
Gender	
Male	2
Female	4
Total number of participants	6

Table A.3: Overview of teachers interviewed

D.6. Method

Script:

Explanation of the project and requesting permission to record
Signing of forms

Questions:

1. Ask what subject they teach
2. Being a Teacher:
    - Why did you become a teacher?
    - According to you, what makes a good teacher?
    - Do you follow the teaching methods provided by educational publishers?

3. Work:
    - What are all the tasks you need to do for work?
    - Write down on pieces of paper (see Figure A.2)
    - How much time do you spend on these tasks?
        - Grouping into:
            - Activities with colleagues
            - Collaborations
            - Bond between teachers
            - When do they engage in activities together?
            - What activities do they do together?
        - Activities with students
        - Individual activities
    - Value for the teacher -> please lay down the tasks on this paper, the smallest layer is should contain the tasks that you believe are most important and give you the most energy (Figure A.3)

4. Digitalization:
    - Do students mainly work online or in person?
    - How much of the work is digital and what is done physically/on paper?

5. ChatGPT:
    - Have any parts of your subject been adjusted due to the introduction of ChatGPT?
    - Do you have conversations with others at school about ChatGPT? (colleagues, students, parents)

6. If they use ChatGPT:
    - How do you use ChatGPT for your work?
    - In which aspects of your work do you use ChatGPT? (indicate on a sheet with a dot)
    - How can ChatGPT assist you in the subject you teach?

D.7. Limitations

Recruitment of teachers depended on the availability and willingness of teachers to be interviewed, which limited our control over the interview participants. In addition, all teachers interviewed expressed an interest in AI during the interviews, resulting in a biased view of teachers' perspectives on the topic.

Appendix E - Factors VIP method

state | trend | principle | development

Cultural

- in secondary education, the well-being of LGBTQ+ students and girls is found to be less good than that of non-LGBTQ+ individuals and boys (Veiligheidsmonitor 2021-2022 - School En Veiligheid, 2023)
- there are conferences, workshops, lectures that are there to learn people about the possibilities of generative AI for education (De Nationale AI-Cursus, n.d.)
- Compulsive social media use negatively impacts young people (11-18), leading to poorer academic performance and concentration issues. (Cavdar, 2023; (Van Den Eijnden et al., 2019)
- Institutions are setting up workshops etc to teach teachers about AI (NL AI Coalitie, 2023)
- game-based learning in education is not new, the use of game-based learning solutions is exploding in popularity. (Neendoor, 2023; (Darwesh, 2016)
- there is an observed increase in unwanted (sexual) behaviour from 14% to 17%, which is explained by a rise in the distribution of unwanted sexually explicit photos and videos. (Veiligheidsmonitor 2021-2022 - School En Veiligheid, 2023)
- teachers believe GenAI was a hype, and they now can go back to the way it was (Thijmen Sprakel, Interview, October 9, 2023)
- trust is a crucial part at AI at schools for teachers and use (European Parliament, 2020)
- digitisation of education reinforces inequality of opportunity among students (Dijck, 2020)
- online learning gives students flexibility (Academy_Admin, 2023; (Cursum, 2022)
- Verbal violence is on the rise.
  - Students: 32%
  - Staff: 28%

  (Veiligheidsmonitor 2021-2022 - School En Veiligheid, 2023)
- AI will have profound impacts on privacy in the next decade. (European Parliament, 2020)
- The ICT skills students have are strongly related to their socioeconomic background. (Van De Werfhorst et al., 2023)
- more and more schools are experimenting different ways to assess students (Samplonius, 2022; Schildkamp, 2023; Petra Prescher, Interview, October 10, 2023)
- AI will impact education, it is compared to the invention of the car (Eva Leurink, Interview, October 5, 2023)

Psychological

- Teachers struggle to give accurate grades to students needing special support in regular education. They often adjust grades to protect self-esteem. (Nationaal Regieorgaan Onderwijsonderzoek, 2019)
- Girls in secondary education reported significantly more problems on all scales of the SDQ in 2021 compared to 2017 (Nederlands Jeugdinstituut, 2023c)
- Children may adjust their performance to align with the misfit expectations, thus setting in motion a self-fulfilling prophecy. (Smeets et al., 2022)
- the number of students in secondary education who experience pressure due to schoolwork has increased significantly (Nederlands Jeugdinstituut, 2023c)
- more and more schools are experimenting different ways to assess students (Samplonius, 2022; Schildkamp, 2023; Petra Prescher, Interview, October 10, 2023)
- AI causes a fear of unemployment (Liang Lee, 2017)
- you need to be an expert in a field to find the mistakes made by ChatGPT (Petra Prescher, Interview, October 10, 2023)
- An important aspect of your personal identity is the feeling that you are unique and distinct from others. (Sollie et al., 2023)
- Poor mental-health during childhood correlates negatively with educational attainment. (Brännlund et al., 2017)
- Teachers find fulfilment in positive student relationships (Koomen, 2013)
- school and homework are the biggest driver of stress for students (Nederlands Jeugdinstituut, 2023c)
- people will only use something if they can trust it (Lorenz, n.d.)

Demographic

- there is a 'digital divide,' where one student benefits more from digital learning resources than another. (Ministerie van Justitie en Veiligheid, 2022)
- Two-thirds of the surveyed teachers indicate that their students are already using AI for their schoolwork. (Quekel, 2023)
- 16-25 year olds have less people that have basic digital skills than 25-45 year olds, after 45 it decreases (Centraal Bureau voor de Statistiek, 2022)
- one out of four US individuals experience FARAI. most people have not interacted with a robot (Kieslich et al., 2021)
- majority of people do not believe that AI will take over humanity (Gherheș, 2018)
- 39% of secondary education students say they spend less time on homework and schoolwork due to smartphone usage (Nederlands Jeugdinstituut, 2023a)
- In 2021, 70.1 percent of girls in secondary education reported experiencing psychosomatic complaints more than once a week. (Nederlands Jeugdinstituut, 2023c)
- 10 percent of young people aged 15 to 25 report being victims of online threats and intimidation in 2022. (Nederlands Jeugdinstituut, 2023b)
- 42% of teachers fear to get a burnout (Teacher Tapp, 2023)
- 45% of teachers fear results of their students aren't good enough (Teacher Tapp, 2023)
- 76 percent of parents believe that schools do not possess enough knowledge to educate children about AI. (Quekel, 2023)

Biology & evolutionary

- Gen Alphas have speed of browsing, have need for short answers and immediate feed-back and have preference for multitasking behaviour. All these are obstacles in the development of critical thinking, which takes time, attention, or interest for details (Drugaș, 2022)
- Generation_I has completely embraced digital technology which has become an essential part of their lives today. (Jain, 2013; Piersma & Wiggers, 2023)
- humans don't react well to change as they want to protect themselves (Juma, 2016)
- humans are creatures of habit (Greenberg & Baron, 2017)
- adapting the content and the experience to each learner usually leads to better user retention and a more meaningful and deeper learning experience (Demir, 2021; Ackermann et al., 2019; (Chiotaki et al., 2023)
- covid has positively influenced the digitalisation of education, the independence of students and the involvement of parents (Onderzoek Naar Corona En Onderwijs, 2023)
- resist to change is created by the failure to recognise the need for change (J. Zimmerman, 2006)
- "One Size Fits All" Doesn't Work In Education (Mead, n.d.; (Lynch, 2020)
- teacher will become the expert in their fields (Eva Leurink, Interview, October 5, 2023)
- humans fear the uncertainty of the future (Godbole, 2017)

Ethics

- The Dutch Data Protection Authority (Autoriteit Persoonsgegevens) has raised concerns about AI chatbots and their potential risks to children. Children may not be fully aware of these risks (RTL Nieuws, 2023)
- it should always be possible to find out why an autonomous system made a particular decision, especially if that decision caused harm (European Parliament, 2020)
- Digitalization has created opportunities and risks. We must help our young people develop an understanding of this. (Digitale Geletterdheid in Het Voortgezet Onderwijs - KNAW, n.d.)
- generative AI has a race and gender bias (International Women's Day, n.d.)
- people trust AI generated faces more than actual human faces (World Economic Forum, 2023b)
- Gender education needs more attention throughout Dutch secondary education. (Sanders, 2023)

Politics & democracy

- AI act is passed as a draft law to ensure safe, transparent, traceable, non-discriminatory and environmentally friendly use (European Parliament, 2023)
- Generative AI, like ChatGPT, would have to comply with transparency requirements:
  - Disclosing that the content was generated by AI
  - Designing the model to prevent it from generating illegal content
  - Publishing summaries of copyrighted data used for training

  (European Parliament, 2023)
- Dutch politics want to start an international discussion on the Legislation and regulations around chatbots with children and young adults (NOS, 2023b)

Sustainability & ecology

- big AI models like OpenAI have a big energy consumption (Barth, 2023)

Technological

there are dashboards to track students progress and give individual feedback (Snappet Nederland B.V., 2023; (Gynzy, n.d.; Schildkamp, 2023; (Baidoo-Anu & Ansah, 2023; Ministerie van Onderwijs, Cultuur en Wetenschap, 2023a)

the effective use of computers is associated with training teachers in using computers as a teaching and learning tool. (Timotheou et al., 2022)

teachers' personal characteristics (e.g., anxiety, self-efficacy) are associated with their satisfaction and engagement with technology. (Timotheou et al., 2022)

users need to put in considerable effort to make a digital tool work. Training on how to use these digital tools is often required, adding to the workload of teachers. (Piersma & Wiggers, 2023)

Generative AI contains a black box (Schildkamp, 2023)

NL is the top leader in skills in digital literacy (Centraal Bureau voor de Statistiek, 2022)

Companies are making teaching buddies for kids containing AI (Khan Academy, n.d.)

the higher the level of education, the better the digital skills (Centraal Bureau voor de Statistiek, 2022)

students need to obtain computational thinking (Computational Thinking, n.d.; (AG Connect, 2022)

digital literacy has an agenda at schools since 2020 (European Commission, 2020)

technical support and access to technology will influence the use of teachers of the technology (Timotheou et al., 2022)

Few teachers are still training to become computer science instructors. (KNAW, 2013)

most teachers do not know what you can do with GenAI for work (Ewald van Vliet, Interview, October 13, 2023)

most teachers do not know what you can do with GenAI for work (Ewald van Vliet, Interview, October 13, 2023)

with deepfake you can make a "copy" of yourself (Brooks et al., 2022)

online learning demands tech savy teachers (Piersma & Wiggers, 2023;)

Smart learning is on the rise and has great benefits for both students and teachers (Demir, 2021)

Digital tools are sometimes challenging to understand for both students and teachers. They often come with numerous complex features and settings that can lead to frustration and non-usage. (Piersma & Wiggers, 2023)

a small group of teachers is very against the use of technology at school (Ewald van Vliet, Interview, October 13, 2023)

in many cases the precise reasons why LLMs behave the way they do, are not known — even to their own creators. (Nature, 2023)

Games are the most famous and effective tools used in education because of the popularity of many kind of game devices and applications. (Darwesh, 2016)

more and more schools are experimenting different ways to assess students (Samplonius, 2022; Schildkamp, 2023; Petra Prescher, Interview, October 10, 2023)

Finance & labor

there is a shortage on teachers in high school education (VO Raad, 2023)

According to a specialized report published by Forrester Research Company, the development of Artificial Intelligence (AI) will lead to the disappearance of 24.7 million jobs by 2027. (Gherheș, 2018)

informatica will have the highest shortage in teachers out of all subjects (VO Raad, 2023)

Automation has barely increased, while labor shortages in the Dutch job market persist. (Universiteit van Amsterdam, 2023)

schools will not receive extra money anymore to catch up with the covid backlog of students (Khaddari, 2023)

many teachers who said they knew about workload challenges before starting teaching left the profession, it was still the main reason they mentioned for leaving (Perryman & Calvert, 2019)

The percentage of teachers aged 50 and over has been declining for several years (Ministerie van Onderwijs, Cultuur en Wetenschap, 2023b)

1/3 of novice teachers has a pedagogical and didactic level is below the expected starting level (Helms-Lorenz et al., 2019)

in 2030, almost 6% fewer full-time equivalent (FTE) teachers will be needed than in 2020. (Ministerie van Onderwijs, Cultuur en Wetenschap, 2022)

Sociology

Students develop a close relationship with their teacher in a physical classroom. (Academy_Admin, 2023; Cursum, 2022)

The alignment of expectations between teachers and parents contributes to a healthy development, a supportive learning environment (both at home and at school), and optimal performance of the child. (Sollie et al., 2023)

trust in AI can only be attained by fairness, transparency, accountability and regulation. (Floridi, 2016; Floridi and Taddeo, 2016).

humans don't react well to change as it could affect their relationships in an organisation (Juma, 2016)

Receiving compliments from the teacher has a positive effect on the self-confidence of students. (Nationaal Regieorgaan Onderwijsonderzoek, 2019)

Autonomy support, teacher support, and self-efficacy are important pillars when setting and striving for goals for students (Van Kammen, 2022)

During adolescence, social relationships, including whether you 'fit in' and how others perceive you, play a significant role in the development of the sense of uniqueness. (Sollie et al., 2023)

Feedback enhances motivation, builds trust between teachers and students, and promotes collaboration among students. (Nationaal Regieorgaan Onderwijsonderzoek, 2019)

Information sharing can be social; young people sometimes share passwords as a sign of affection. (KNAW, 2013)

dissent amongst the workforce to change is lack of communication around the reasons for the change (Godbole, 2017)

teachers should help student to become self-regulating learners (Samplonius, 2022)

expectations of teachers allign with the skills of a student better than the expectations of parents (Sollie et al., 2023)

online learning provides less interaction with others than physical learning (Academy_Admin, 2023; Cursum, 2022)

Children whose teachers have low expectations tend to experience a less stimulating learning environment compared to children whose teachers have high expectations. this causes boredom and less motivation (Sollie et al., 2023)

Teachers' lack of ICT skills and familiarisation with technologies can become a constraint to the effective use of technology in the classroom (Timotheou et al., 2022)

Theory of mind is essential for effective communication and cooperation with other intelligent agents, as it allows one to infer their goals, preferences, motives, and expectations, and to adjust one's own actions and utterances accordingly. (Veltman et al., 2018)

Appendix F - Creative sessions

F.1. Goal

Before embarking on the design and creation of concepts, it was considered important to understand what individuals considered essential in educational design. The aim was to identify the desired concept qualities necessary for the design to be effective and meaningful. This step ensured that the foundation was laid for the development of a relevant and impactful design.

F.2. Approach

Two creative sessions were organised, each involving small groups of industrial design students. Design students were selected for these sessions because of their ability to easily articulate their creative ideas and rationale for proposed actions. Their familiarity with design principles and processes made them well-suited to contribute meaningfully to the discussions and activities conducted during these sessions.

For these creative sessions, creative problem-solving techniques formulated by Katrina Heijne and Han van der Meer (2019) were used. Their techniques allow people to be creative, which leads to novel and useful solutions. Therefore, it was well suited to the aim of these sessions. Their techniques follow Guilford's (1961) divergent convergent thinking. Divergent thinking involves trying to generate as many ideas as possible. The idea is that quantity produces quality. Then you use convergent thinking to look critically at the ideas you have generated. This way you can select the best ideas. In Table A.4, the setup of the session can be found. The same setup was used for both sessions. The sessions include two phases of divergent and convergent thinking. The first phase focuses on the problem at hand. The result of this phase is a reformulation of the problem. This allows everyone to be on the same page with the problem at hand and to fully understand what they are designing for. The second phase focuses on idea generation. The outcome of the sessions were used to formulate desired concept qualities for the concept.

F.3. Method

Script and planning:

Phase	Time	What exercise?	What shoud I say?	What do I need?
Phase 1: Problem finding	5	Short introduction of everyone		
	15	Explanation graduation		Ppt & scherm
	5	Energizer - Only answer with a question	We will form two rows and ask each other questions	
	5	Purge	Write down anything that is on your mind, doesn't have to do with the PaP, can do with the PaP	Big sheet of paper & post its
	15	H2 with words	Enthusiasm, promote, create awareness	Three sheets with the words written on them
	10	Hits and dots		Dots stickers
	10	Statement PaP	Remind them of the context of high school	
	10	Break		Write down the important words of the PaP created
Phase 2: Idea finding	5	Energizer - Ways to put on pants	We will do a round and everybody has to say a way to put on pants, clap when you're done	
	5	Purge	Write down everything you can think of for the PaP	Big sheet of paper & post its
	20	Absurd questioning	Purpose: generate ideas beyond the obvious force fit ideas	Write simplified PaP on sheet and pick three words, write down the levels: nearby, more creative & absurd
	15	C-Box	Put down the ideas in the c-box	Big sheet of paper with axis

Table A.4: Set-up creative session

Appendix G - Overview of existing products

G.1. Research goal

Before creating something of our own, it is important to know if there is already a product that gives teachers clear information about generative AI and allows them to experiment with it. Therefore, it was desired to first determine whether there were already suitable products on the market.

G.2. Approach

Research was conducted to uncover existing products relevant to Artificial Intelligence (AI) in education. This process involved online scouting using keywords in both Dutch and English, namely: ‘AI and education’, ‘AI in school’, ‘AI lessons for school’ and ‘AI products for school’.The products were evaluated according to the following criteria:

- Whether the product discussed Generative AI specifically or AI more broadly.
- Whether students and/or teachers would use Generative AI through the product.
- Whether critical knowledge about Generative AI was covered.
- The time required for teachers to acquire the necessary knowledge and skills in Generative AI.

Based on this evaluation, eight products were identified as the most interesting for this project. A comprehensive overview of these products can be found in Table A.5.

In a later phase of the project, these products were then used to guide the development of the website. The columns with a yellow background represent the lessons learned in the development of the website.

Naam	Nationale AI cursus Junior	AI Literacy Lessons for Grades 6–12	Stanford CRAFT	DAILy Workshop	Elements of AI	Onderwijs op afstand	AIvoordocenten
Link	https://futurenl.org/nationale-ai-cursus-junior-vo/	https://www.commonsense.org/education/collections/ai-literacy-lessons-for-grades-6-12	https://craft.stanford.edu/dash/resources	https://raise.mit.edu/daily/	https://www.elementsofai.com/	https://onderwijs-op-afstand.nl/ai-didactiek/werkvormen-ai-voor-het-voortgezet-onderwijs-vo/	https://aivoordocenten.com/prompts/
Why	Make students understand how AI works and aware of potential risks and ethical considerations. Generative AI is not used by students	Make students and teachers understand how AI works, aware of the benefits and risks. Next to that, make students responsible and ethical users of AI. Generative AI is not used by students	CRAFT is a collection of co-designed free AI Literacy resources about AI for high school teachers, to help students explore, understand, question, and critique AI. Generative AI is used by students in some lessons	It is critical for all students to have fundamental knowledge of AI and to understand AI's potential for good and harm. Generative AI is used by students in some lessons	We want to encourage as broad a group of people as possible to learn what AI is, what can (and can't) be done with AI, and how to start creating AI methods. Generative AI is not used by students	Ensure that students are equipped with the skills that the future will demand of them and critical thinking skills. Generative AI is used by students in some lessons	Provides prompts for teachers, in depth explanation of ChatGPT on the risks, the opportunities and how to prompt.

What	5 lessons (that have to go in order) about AI in general including:
	• how is it trained?
	• what is AI bias?
	• AI chatbot friendship
	• AI and privacy of data
		8 lessons about AI in general including:
		• how is it trained?
		• what is AI bias?
		• AI chatbot friendship
		• Disclaimer to never fully trust the outcome of GenAI as it can make mistakes
			11 lessons that have different subjects, including:
			• Bias
			• Examples of AI in daily life AI algorithms
			• Generative AI focussed:
			  • Examples of Generative AI (images)
			  • Prompt examples
			  • Use Generative AI for art
			  • Use Generative AI for debate
			  • Form opinion on experience of using Generative AI
				4 lessons (that have to go in order) about
				• What is an algorithm
				• Bias
				• AI vs. GenAI
				• Neural networks of AI
				• Spread of misinformation
				• Try out GenAI and form their opinion on it
				• Write a story with GenAI
					Two parts
					
					Part 1: Introduction to AI
					• What is AI
					• AI in daily life
					• Machine Learning
					• Neural networks
					
					Part 2: Building AI
					• Why AI matters
					• Machine learning
					• Neural networks
						16 lessons on AI, most concerning ChatGPT
						• Some contain exercises with ChatGPT
						  • Write a story with ChatGPT
						  • Write a future scenario with ChatGPT
						  • Debate with ChatGPT
						  • ChatGPT as an expert
						  • Check misinformation of ChatGPT
						  • Do a guessing game with ChatGPT
						• Some discuss ChatGPT
							Page: Prompt library to use in ChatGPT (preferably ChatGPT plus)
							Page: How to use ChatGPT
							• How to prompt
							• Risks
							• How to use for schoolwork
							  • How to prompt
							Page: Two other AI tools are mentioned
							Page: Generating images
							Page: Risks of generative AI
							Page: future scenarios of ChatGPT on school

Time	60 minutes per lesson	20 minutes per lesson	No time is stated	60 minutes per lesson	Around 100 hours	60-120 minutes per lesson	-
Target group of lesson	10-14 year old	12-18 year old	High school	13-18 year old	Adults	High school	Teachers
What information is given on the website?	Target group Objective of the lesson Key concepts Time of lesson Lesson structure Materials Tip for good preparation	Target group Objective of the lesson Key concepts Time of lesson Lesson plan Materials	Objective of the lesson Key concepts Materials	Description Key concepts Time Materials Age is mentioned in the script, not on website overview	Introduction into the two parts and why you should do it	Target group Overview of lessons Introduction for each lesson Objective of each lesson Lesson plan with time What materials you need	A lot of information is given on all of the above pages mentioned. They go in detail and repeat quite a lot of information on multiple pages.
What materials are available?	Teacher guide Lesson slides Exercises for the students	Lesson plan Lesson slides	Lesson plan	Script Videos Slides Exercises	As this is more of a workshop, everything can be done on the website. Therefore, there are not added materials that need to be downloaded.	Nothing besides the lesson plan which is really short	Only prompts are available to copy and paste into ChatGPT
Price	Free	Free	Free	Free	Free	Free	Free
Extra insights		Has two sets of lessons that are for teachers. They contain a lot of videos with information on AI and Generative AI. • tips on how to use it for work • tips on how students can use it The lessons take really long, but the goal is the same as mine: educate teachers, then educate students.	When GenAI is used by students in a lesson, there is also a focus to make the students reflect on the use of it. They do this by writing down what they liked and disliked. I will include this.	When GenAI is used by students in a lesson, there is also a focus to make the students reflect on the use of it. They do this by writing down what they liked and disliked. I will include this.		The main objective of the exercises with ChatGPT are to ensure that students critique the outcome The explanation of the lessons and exercises is not detailed enough. The shorter exercises are nice and I will try them in my tests	The website first promotes its workshops that they provide that schools can buy for their teachers. The 3rd page is the first page that provides actual information on generative AI for teachers. The website merely mentions generative AI programs that you have to pay for. The website provides a lot of text, which makes it feel unorganised and overwhelming. It would take quite some time to read and understand everything written on their pages.

Table A.5: Overview of existing products

Appendix H - Concept 1 | Interactive Online module

H.1. Content of concept

The concept includes six chapters about how Generative AI is trained and how it can construct sentences.

H.1.1. The database of Generative AI

This chapter explains what data is used to train Generative AI. It means that not all Generative AI has a live connection to the internet and that ChatGPT 3.5 has been trained on data up to January 2022. This is to ensure students know that when they use ChatGPT for free, the information might not be up to date.

H.1.2. How Generative AI is trained

This chapter briefly explains how Generative AI is trained by humans. The goal of this chapter is to show students that ChatGPT is not something that can read and understand information on its own, but needs to be trained by humans.

H.1.3. How Generative AI constructs sentences

This chapter explains how Generative AI like ChatGPT is able to construct sentences. This chapter shows students that Generative AI does not write sentences like humans do. It needs a lot of calculations before it can form a sentence.

H.1.4. The randomness of Generative AI

This chapter explains that when ChatGPT constructs a sentence, it uses a random factor to generate different pieces of text. It shows students that this random factor can also cause Generative AI to make mistakes and write incorrect information.

H.1.5. The privacy of conversations with Generative AI

This chapter explains that conversations of users with ChatGPT are saved for training purposes, to be able to improve ChatGPT. This shows students that if they share information with ChatGPT, that this will be saved for those training purposes.

H.1.6. The bias in Generative AI

The final chapter explains how trainers of ChatGPT and the database of ChatGPT both have influence on the bias ChatGPT contains when it generates text.

Each chapter begins with a statement that introduces the topic of the chapter. Each chapter also contains one or two exercises to help students actively engage with the content of the chapter. The exercises are done on paper next to the laptop. Figure A.4 shows part of the first two exercises completed by the students. They either take on the role of a ChatGPT trainer or become ChatGPT themselves. Figure A.5 shows an overview of the different screens designed for the concept.

Figure A.4: Part of the first two exercises done on paper

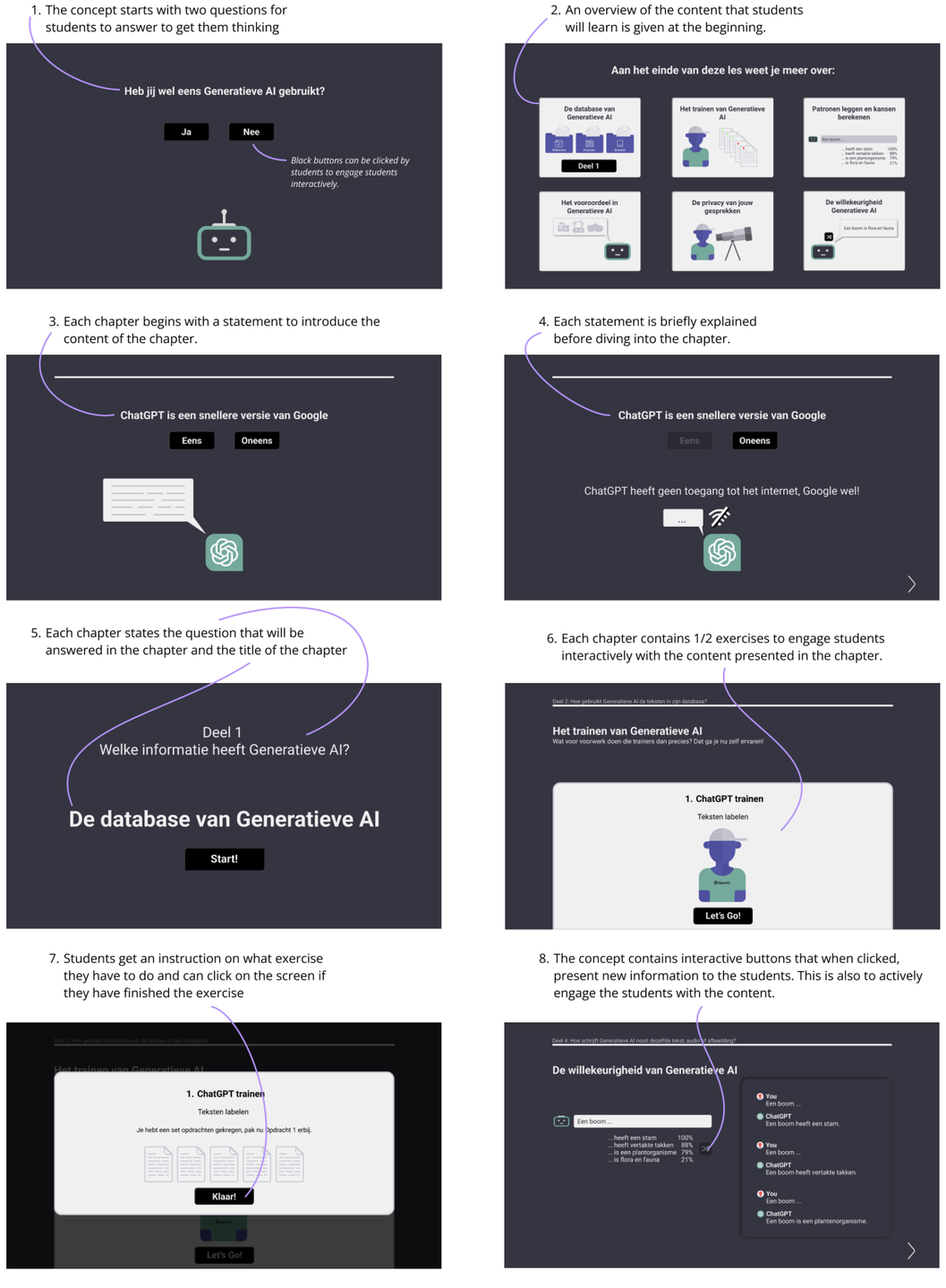


Figure A.5: overview of screen design in concept 1

H.2. Testing

H.2.1. Improving the usability

Goal

Improve the usability of the concept in terms of navigating through the screens of the concept.

Data collection

Observations: During testing, the designer made observations when participants got stuck or understood the design immediately.

Talking out loud: During testing, users were asked to talk about what they were thinking and feeling at the time.

Post-test discussion: After testing, participants are asked to share their thoughts and opinions about the concept.

Location and setup

Tests were done at the faculty of Industrial Design Engineering. The participants were presented with a Figma prototype on the laptop of the designer. All screens of the prototype were printed on paper to be able to make observations during testing.

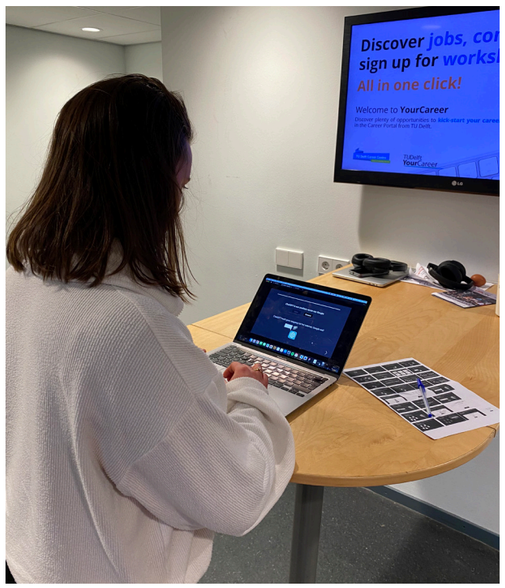


Figure A.6: Example of setup with an Industrial Design masterstudent

Participants

Tests were carried out with four industrial design engineering students. Table A.6 shows an overview of these students.

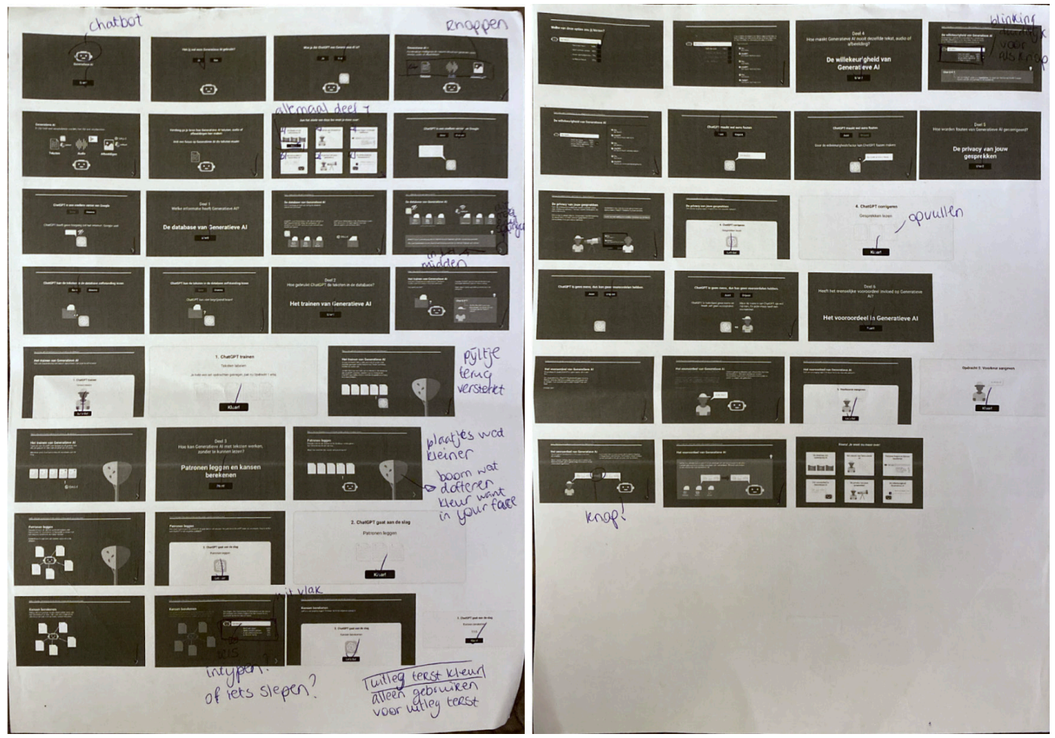
Characteristics	# of participants
Master education	
Master Strategic Product Design	1
Master Integrated Product Design	3
Gender	
Male	3
Female	1
Total	4

Table A.6: Demographics of industrial design engineering students

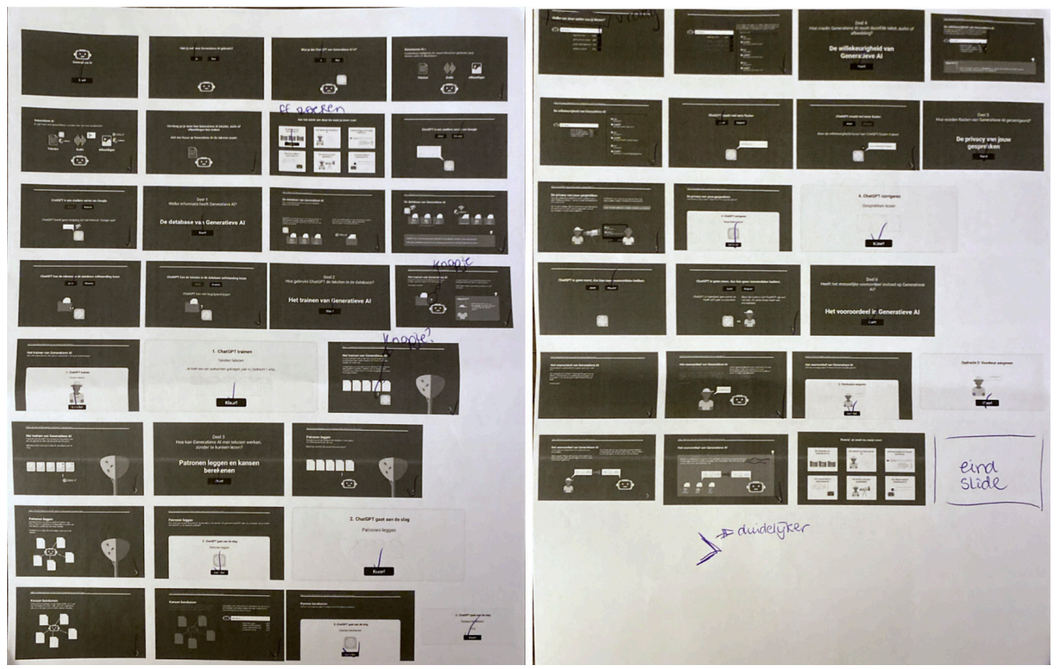
Data

This appendix contains the observation sheets with the designer's notes on how to improve the concept. Based on the observations, a small iteration was made on the buttons within the concept to improve usability. Below all observation sheets are shown.

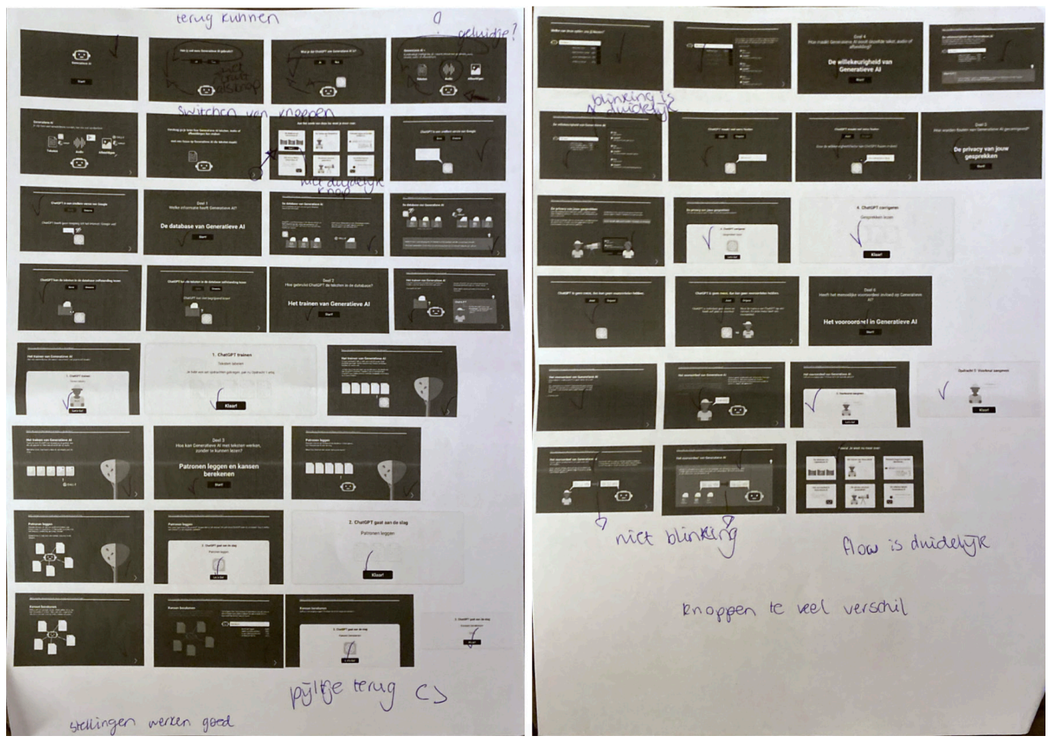
Test 1:



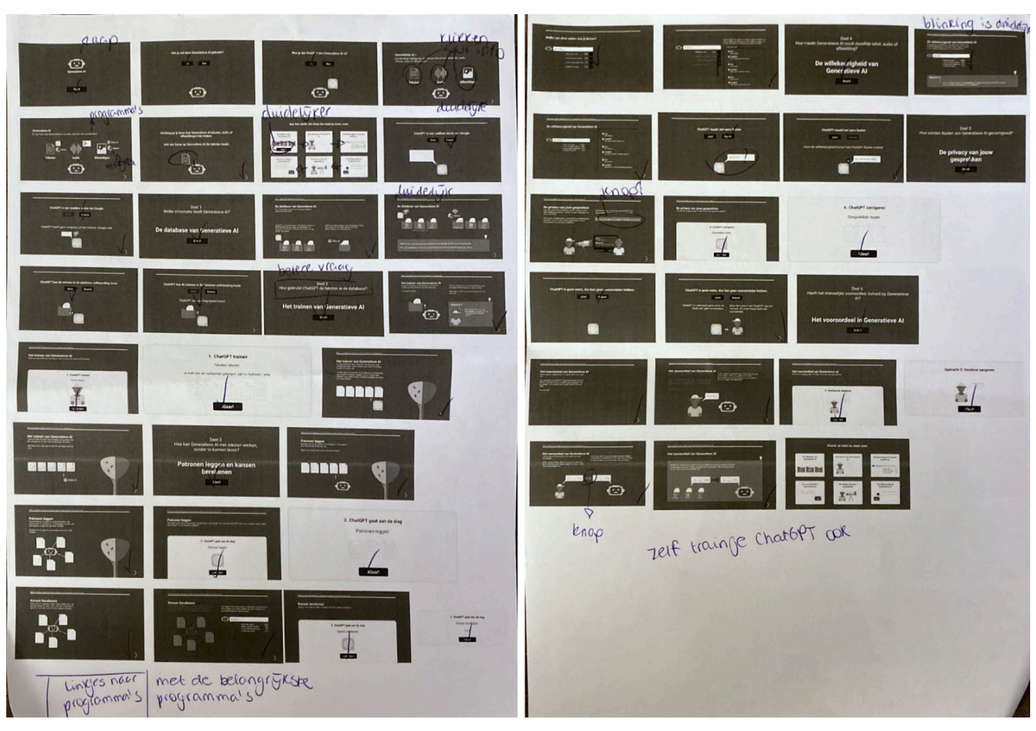
Test 2:



Test 3:



Test 4:



H.2.2. Testing the effectiveness concept 1 in class

Goal

The aim is to assess whether the concept can effectively provide both teachers and students with Generative AI knowledge and experience through interactive and collaborative learning.

Data collection

During testing, observations were made as no video, audio or pictures can be taken with minors. The teacher can see all the laptop screens of the students on his own laptop. This allowed me to see all screens of the students at the same time.

Location and setup

The concept was tested at Christelijk Lyceum Delft in a classroom.

Method

The teacher announced to the class that they would be doing a slightly different class than usual and introduced them to the prototype. They were instructed to work individually.

Participants

Testing was done with two classes of senior general secondary education level. The age of the students was between 16 and 17 years old.

H.2.3. Limitations

Participants to test the usability of the concept were recruited by me, which may have introduced a bias where participants felt pressure to understand the concept well and approve of it for my benefit. In addition, during the testing phase of the concept, our ability to collect feedback depended on the availability and willingness of teachers to implement the concept with their students. As a result, we had limited control over the composition and nature of the classes involved in testing the lesson plan, resulting in only older students participating in the process.

H.3. Findings

H.3.1. Too much information

In general, the students had no problems understanding how to use the concept. They quickly figured out that they could click on certain areas on the screen to go to the next page. Unfortunately, through observations it can be concluded that half of the students did not read the content of the prototype. When observing the screens of the students, you would see some of them clicking through the prototype at a very high speed, which did not allow them to read the content at all. Next to that, if the teacher asked students what they had learned, poor answers were given. For example, one student mentioned that ChatGPT can not have a bias, as it is not human. This made it clear that this student did not read the content about bias.

The other half of the students did work on the prototype. But, also with these students the information did not stick. For example, some students were working with the prototype in a correct way and were very well behaved. When they were finished, they had a discussion with the teacher whether ChatGPT did or did not have access to the internet. So, even after following all the steps of the prototype, the information had not stuck with them.

The limited information that did register primarily revolved around the statements presented in the concept. Quite some students were thinking aloud and we heard them talking about the statements the most. Some students also asked questions about the statements to the teachers, or had a discussion with others whether it was right or wrong, like the example of the student mentioned above. This shows that the concept contained too much information, but also that statements trigger students to discuss with one another.

H.3.2. Physical exercises of prototype

The students knew quite well what to do with the exercises, and did not seem to struggle with these. Some students did not do the exercises until they finished clicking through the concept, because they

did not read the content carefully enough. This defeats the purpose of the exercises unfortunately. Nevertheless, because these students.

H.3.3. Poster crafting with Generative AI

Too much freedom in Miro

Unfortunately, some students took advantage of the freedom they were given in Miro. They started drawing, placing inappropriate pictures, etc. Figure A.7 shows an example of what students created. It was clear that this amount of freedom was not going to work for future tests.

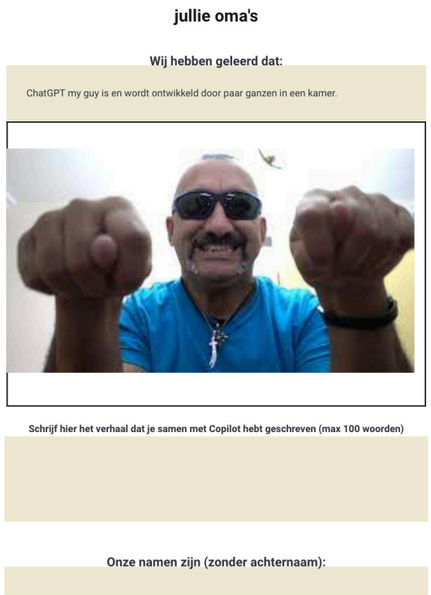


Figure A.7: Example of students not doing the exercise in Miro but playing around

More assistance is needed in prompting

Another assumption made by the design team was that students can easily start off using Copilot. Nevertheless, during testing it was found that students still had a lot of questions on how to actually start using a program like Copilot. Therefore, in future tests more assistance will be required to help students.

H.3.4. General findings

Lack of motivation

One aspect that was overlooked in this concept is that students are attending the class out of obligation rather than intrinsic motivation. This lack of motivation was observed in the students' behavior during the class. Motivation needs to be instilled in students, either through assessments or the assurance that the teacher will review their work. Without such incentives, students may not feel compelled to engage in the tasks.

More involved teacher

In the end, the original plan to actively engage the teacher in the learning process about Generative AI was not fully realized with this concept. The role of the teacher in this concept was more of a policeman, checking if people were actually working. The teacher should be more involved in the concept.

More traditional setup for concept

The teacher present during testing, mentioned that students are used to doing things a certain way. He explained that this concept might be a step too far from the traditional teaching the students are used to. In an attempt to create something Out of the ordinary for the students, we might have taken it a level too far for what these students are used to.

Appendix I - Testing the Lesson module

I.1. Research goal

The goal for this project was: "In a world undergoing digitalisation, I want teachers to engage in social interaction with students while acquiring Generative AI knowledge and experience."

The lesson module aims to do that. Therefore, the goal of testing the lesson module is to see whether it can be used to let teachers and students gain Generative AI knowledge and experience while socially interacting.

I.2. Research question

Is the teacher able to socially interact with students while presenting them with the necessary Generative AI knowledge?

Sub-questions:
AI knowledge
1. Is the teacher able to discuss the statements of the lesson concept with the students?
2. Do the students understand the statements?

AI experience
3. Did the teacher gain experience with GenAI?
4. Did the students gain experience with GenAI?

Criteria:
5. Is the teacher able to use the lesson module without any questions beforehand?
6. Is the concept doable in 50 minutes?

I.3. Data collection

No videos, audio or pictures were taken as we are working with minors.

AI knowledge
Observations: the teachers' ability to provide clear explanations of the statements.
Score of test questions: This aspect aimed to evaluate whether students paid attention and understood the material covered in the lesson.
AI experience
Questions: asking if the teacher was able to use the prompts and what their experience was
Assignments: evaluating if the students were able to finish the assignment

Criteria:
Observation: Does the teacher have any questions on the lesson concept beforehand?
Time tracking: The time tracking component was used to assess whether the concept could be completed within the allotted 50-minute timeframe.

I.4. Location and setup

Testing was done at Christelijk Lyceum Delft. During the testing sessions, the designer was present solely to observe the proceedings. Figure A.8 provides a visual depiction of the classroom setup during the tests.

Figure A.8: Classroom setup during testing

I.5. Participants

Teachers were approached through email correspondence. Thanks to the cooperation of several willing teachers, the lesson module was tested a total of five times, with each test conducted in a different classroom with a different teacher. Table A.7 gives an interview of all tests done at Christelijk Lyceum Delft.

Version of concept	Class	Teacher
Concept 2.1 Exercises: Fake facts Self-portrait	VWO3	English
Concept 2.2 Exercises: Future scenario Brainstorm	HAVO5	Science
Concept 2.3 Exercise: Extension brainstorm with prompting	HAVO5	Biology
Concept 2.4 Exercise: Dependent on information	VWO2	German
Concept 2.5 Exercise: Comparing programs	VWO5	Science

Table A.7: Overview of tests with concept 2 at Christelijk Lyceum Delft

I.6. Method

When testing concept 2, Therefore, only notes could be made during testing. These were recorded on observation sheets. Next to that, any interesting observations are written down as well. These observation sheets are added below.

I.7. Data

Test observation sheet — No. 1, 12/02/2024

- Can the teacher use this concept?

Yes, the teacher had no questions beforehand. During the test she gives her own twist to the slides by involving the students by asking them to share their opinions or experiences.

- Do the students cooperate?

Students are loud but all work on the task sheet given to them.

- Are the students paying attention?

Students are quite loud but when a question is asked they discuss among themselves, which shows that they are paying attention. The students also got 90% correct on the test.

- Do students understand the task?

Yes and no, sometimes students are unclear about what to do & students' answers are very short.

- Can the concept be done in 50 minutes?

Yes, some students weren't able to complete the assignment due to technical problems. But all parts of the lesson concept were completed within the time.

Notes:
Students really enjoyed the false facts exercise and mentioned that Copilot was really bad at making false facts. They laughed at the content generated. Unfortunately, there were technical problems with the self-portrait exercise because the dummy accounts didn't work.

Test observation sheet — No. 2, 15/02/2024

- Can the teacher use this concept?

The teacher hadn't read my email well and didn't look at the material beforehand. He asked me quite some questions during the lesson because of this. Nevertheless, he gives his own twist on the lesson.

- Do the students cooperate?

Yes, they do everything the teacher instructs them to do.

- Are the students paying attention?

Yes, students are discussing among themselves whether a statement is true or not which shows that they are paying attention. The students also got 90% correct on the test.

- Do students understand the task?

For some students it took a bit longer to get started, but they all understood the assignment.

- Can the concept be done in 50 minutes?

Again, technical issues came up when students tried to log into Copilot. I will only make assignments without images for now to avoid students needing to log in.

Notes:
Students were hesitant to use it because they believe Copilot is not trustworthy as you don't know whether the outcome is true. Teacher didn't have Kahoot account so only 10 students could join (free version). Teacher mentioned questions should be more difficult.

Test observation sheet — No. 3, 08/03/2024

- Can the teacher use this concept?

Yes, she was very well prepared and involves the students very good.

- Do the students cooperate?

Yes, one students is really into generative AI and shares all his experiences with generative AI with the class. Students discuss with each other and give reasoning why they agree with certain statements.

- Are the students paying attention?

Students are quiet and seem to be interested. Again they scored really high on the test.

- Do students understand the task?

Yes, two students first started playing with Copilot, but finally all students worked on the assignment.

- Can the concept be done in 50 minutes?

Yes, with the exception of some students who didn't finish the assignment because they were first doing other things.

Notes:
Two students from a previous class mentioned that they have used Copilot a lot as a result of the lesson. It was fun to see students share their experience with generative AI.

Test observation sheet — No. 4, 14/03/2024

- Can the teacher use this concept?

The teacher just clicks through the slides and doesn't say anything, doesn't encourage discussion or asks the students questions.

- Do the students cooperate?

Yes, they do everything the teacher instructs them to do.

- Are the students paying attention?

Yes, students are discussing among themselves whether a statement is true or not, but again the teacher states they have to be quiet.

- Do students understand the task?

Students couldn't do the assignment because Copilot was acting up again and they couldn't access the website.

- Can the concept be done in 50 minutes?

This cannot be applied because of the technical issues. It couldn't be measured.

Notes:
Teacher had to cancel last minute, so another teacher took over the lesson. She didn't know anything about generative AI and couldn't prepare the slides. For the other tests I will ask the students to sign up because there is no other option. I need to make an answer sheet for the statements so that all teachers can use this to explain the statements.

Test observation sheet — No. 5, 18/03/2024

- Can the teacher use this concept?

Yes, she was really well prepared. She even printed our all the materials and used these while going through the slidedeck.

- Do the students cooperate?

Yes, they do everything the teacher instructs them to do. They all really went into the assignment in pairs which was nice to see. They discussed in their pairs about the outcome of Copilot as well.

- Are the students paying attention?

Yes, students are discussing among themselves whether a statement is true or not which shows that they are paying attention. The students almost got all questions correct.

- Do students understand the task?

The teacher gave a really clear explanation of the assignment for the students which helped the students to start working.

- Can the concept be done in 50 minutes?

Yes, all students managed to finish the exercises and there was even time for a final discussion at the end. I received the most finished assignment from this test.

Notes:
Students work well in pairs and it allows them to discuss the outcome of Copilot and Perplexity and share their opinions. They formed an opinion on whether to use it for school and were critical of the outcome of the generative AI programs.

Appendix J - Iteration lesson materials and exercises

J.1. Iterations of materials through tests

Table A.8 gives an overview of all iterations done on the materials used. These materials are the slidedeck, test questions, assignment sheet, a Padlet and an instruction sheet.

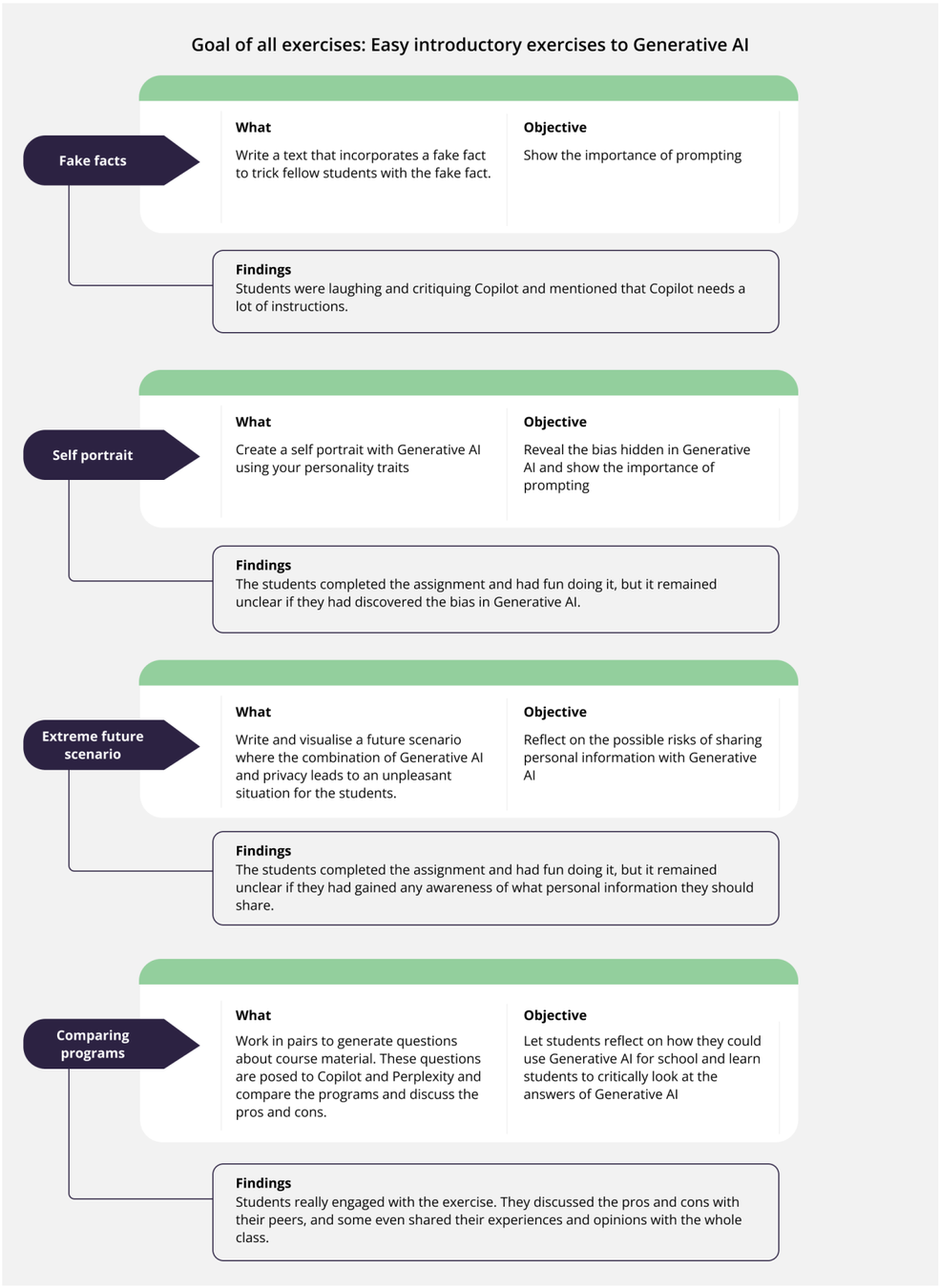
	Slidedeck	Test questions	Assignment sheet	Padlet	Instructions sheet
What	Short and concise Information on generative AI	Short and concise questions with 'Yes' or 'No' answer in Kahoot	Contained the exercise that the students would do with prompts ready to use	Students can download and upload the assignment sheet	Instructions to access Copilot with dummy accounts so that students don't need to log into Copilot themselves
Test 1	Worked well for both teacher and students	Students are discussing which answer they believe is true. Worked well for both teacher and students	Sometimes unclear to students what they should do & The answers of students are really short	Worked OK Quite some questions on how to download and upload files Students and teacher asked if they should send the assignment sheet to the teacher	The dummy accounts didn't work in all cases. Students also couldn't sign up with their school email. It caused a technical hassle.
Changes for next test	-	-	Made it more clear what the prompts are and where they should leave their answers on the assignment sheet	-	-
Test 2	Teacher mentioned students should learn how to prompt	Teacher didn't have Kahoot account so only 10 students could join (free version)	Improved but still a bit unclear for students what they should do & Answers of students are	Same as test 1	Same as test 1

		Teacher mentioned questions should be more difficult	really short		
Changes for next test	Add slides on how to prompt	Test questions are made more difficult and the answers options are more (ABCD)	Add prompting into the exercise & Add sub questions to get more answers & Small iteration on clearer setup	Remove Padlet & send assignment sheet directly to students and let them send the sheet to the teacher	Not use exercises with images to avoid students needing to sign up
Test 3	Students raise their hands to share their experiences & Teacher gave extra explanation for the misconceptions	Students are discussing which answer they believe is true.	Exercise became to long due to prompting & Answers of students are still really short		
Changes for next test	Teacher themselves changed the whole slidedeck into a online LessonUp	Teacher added the test questions to the LessonUp	Split exercise into 2 parts and finish each part with a short discussion with the whole class and teacher to hopefully get better answers from students through discussion		
Test 4: The teacher was unable to attend last minute and requested another teacher to step in, who was therefore unprepared.	Substitute teacher had issues using LessonUp Teacher didn't discuss any slide and just let the students read the slides	Teacher didn't explain any of the answers, but it was noticed that students had questions	Couldn't do exercise because Copilot and other genAI programs all required the students to sign up and this wasn't doable in the time left. Thus, couldn't do discussion		
Changes for the next test	Misconception statements and test questions overlap too much. So combined them in the slidedeck to make time for more discussions as these were really interesting during all tests. Added a summary slide with the necessary generative AI knowledge and a learning goals slide.	Make an answer sheet for the teacher so all teachers can discuss the test questions	Ask teacher beforehand if students can make an account on Copilot. Create exercise where students have to work together to stimulate more discussion		
Test 5	Teacher explained slides well and gave space for the students to share their opinion/knowledge Teacher mentioned a need to learn students how to prompt	Teacher gave great explanation for the answers	Students still gave short answers on assignment sheet, but in the end discussion five students shared their experiences. Also, students discussed amongst each other what their opinion was on the genAI program.		

Table A.8: Overview of all iterations made on lesson materials as a result of testing

J.2. Iterations of exercises through tests

In the overview shown in Figure A.9, all exercises created during the project are shown. For each exercises, the content, objective and findings of the exercise are discussed. The exercise 'Dependent on information' could not be tested correctly due to technical problems with Copilot. The ‘Generative AI as a tool’ exercise was created based on the results of the previous tests. Due to the time constraints of the project, it wasn't possible to test this exercise.



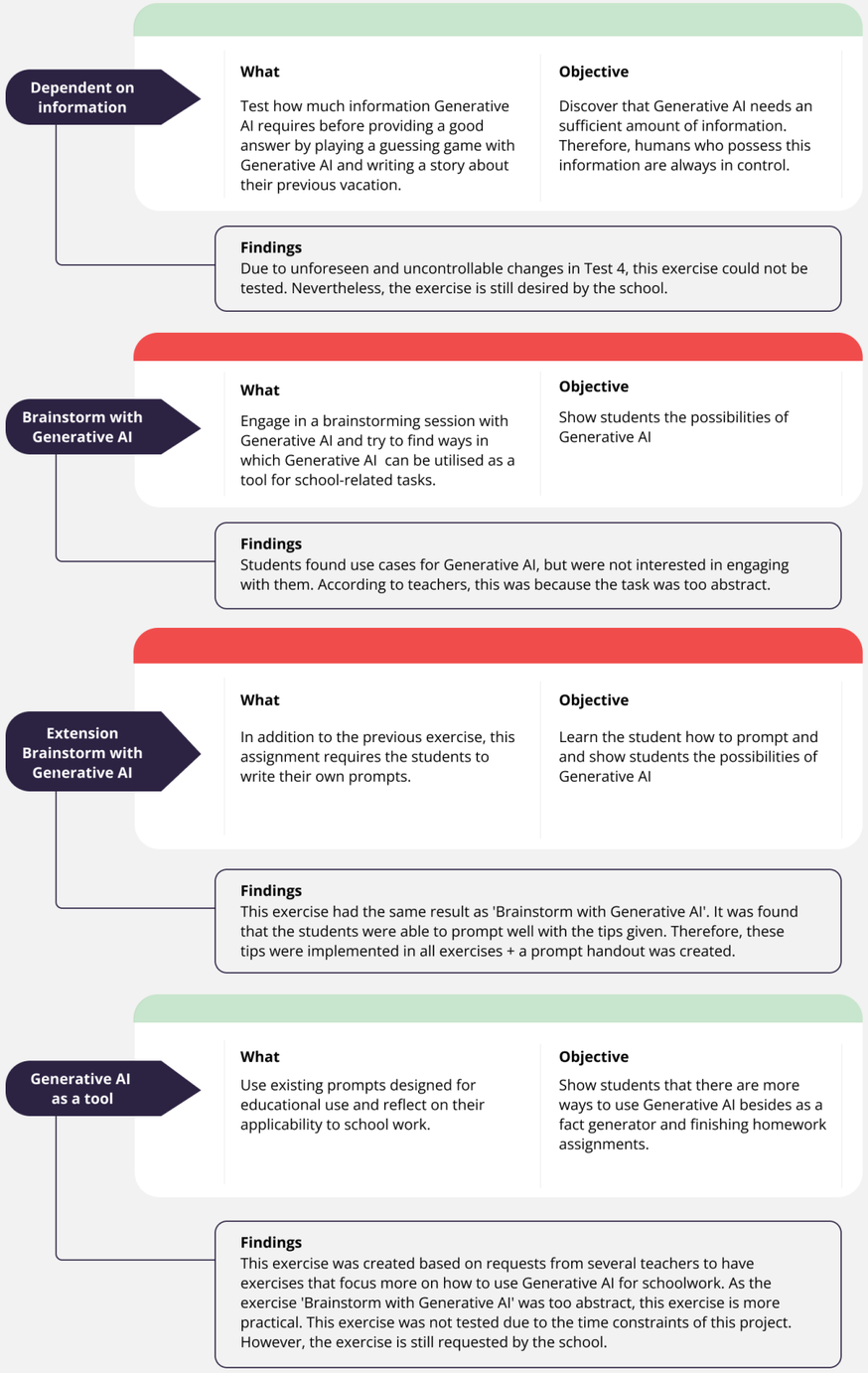


Figure A.9: Overview of exercises created during this project

Appendix K - Feedback sessions with teachers

K.1. Goal

The aim of the feedback session was to gain insight into how to ensure that students engage in meaningful reflection during the exercises and to determine the appropriate level of difficulty for the tasks

K.2. Setup

A feedback session was organised with teachers from the AI Inspiration group. Teachers were also asked for input on the test questions.

The feedback session was conducted online to accommodate teachers' schedules, and materials were sent in advance for their review. The discussion was facilitated using Canva Whiteboard, a platform familiar to all the teachers, which streamlined the process and allowed for collaborative input. The Canva Whiteboard setup is shown in Figure A.10.

K.3. Participants

Feedback was provided by three teachers from the AI Inspiration group. Their characteristics are shown in Table A.9.

Characteristics	# of teachers
Job title	
Deputy headmaster	1
ICT coordinator	1
Examination board	1
Gender	
Male	1
Female	2
Total	3

Table A.9: Overview of teachers interviewed

K.4. Limitations

Feedback on the exercises and test questions was given by only three teachers, each with different areas of expertise. However, it would be beneficial to gather feedback from a larger and more diverse group of teachers. Relying solely on the AI inspiration group may result in test exercises that are more challenging for teachers without prior knowledge of GenAI.

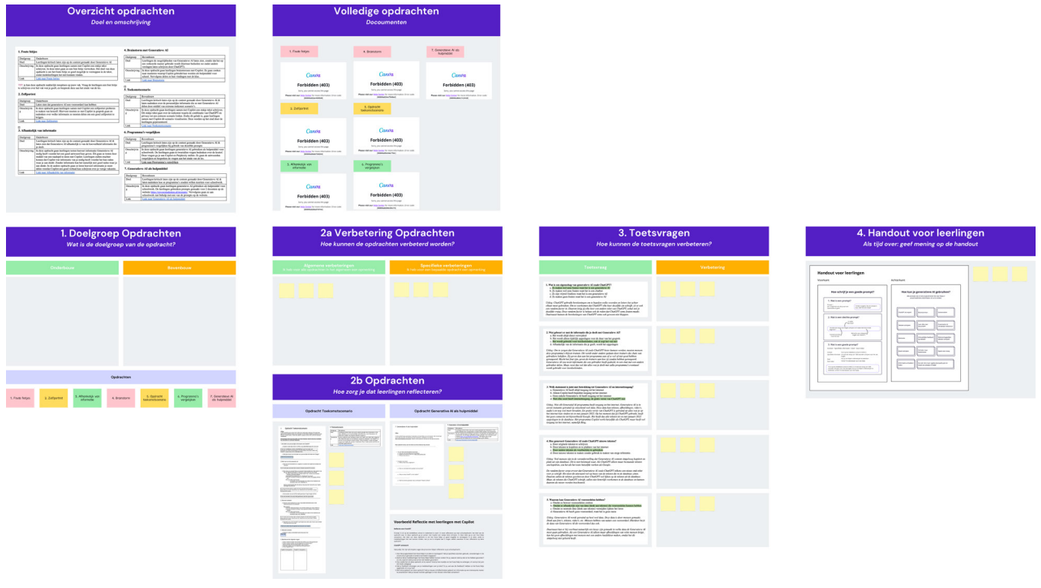


Figure A.10: Feedback session setup with teachers

Appendix L - Survey interest lesson concept & website

L.1. Research goal

Measure the level of interest among teachers at Christelijk Lyceum Delft for a lesson module and a website on GenAI.

L2. Method

In order to reach teachers in the most convenient and efficient way, a survey was used. This survey included both open and closed questions about their attitudes towards Generative AI and their opinions on the use of ChatGPT in schools. The survey also included questions about what information teachers and students should and would like to know about Generative AI.

L.3. Participants

A survey was published in the school's weekly digital newspaper and distributed to all teachers through email. Table A.10 provides an overview of the characteristics of the teachers. As depicted in the Table, only a quarter of the teachers have not used ChatGPT, and half of them hold a positive attitude towards ChatGPT. Consequently, the outcomes of the survey may reflect a particular view of teachers. However, since our current focus is on targeting teachers with an interest in ChatGPT, this is not considered a limitation at present. Furthermore, the Table illustrates a diverse range of subjects taught by the teachers, ensuring a wide representation of different teacher backgrounds among those interested in AI.

Characteristics	# of teachers
ChatGPT usage	
Yes	16
No	5
ChatGPT attitude	
Positive	10
Negative	0
Neutral	10
Subject they teach	
Physics	1
Dutch	5
Science	1
Drawing	1
German	1
Mathematics	1
Gymnastics	1
English	1
Geography	1
Religion	1
Biology	2
Economics	1
Total number of teachers	21

Table A.10: Overview of teachers interviewed

L.4. Setup

This survey was used to measure whether teachers would be interested in having access to the lesson module and website. It also aimed to find out what teachers think should be taught about GenAI and what they would like to learn about GenAI. This section presents the questions from the survey and a short reasoning for them. The school mentioned that teachers receive a lot of surveys, so it was deliberately decided to keep the survey as short as possible for teachers.

First questions to know what kind of teachers we are dealing with:

1. Can you briefly write down which subject you teach and which classes you teach?
2. Have you ever used generative AI (like ChatGPT)?
    - Yes
    - No

Questions regarding the lesson concept:

3. Are you positive or negative about using generative AI at school?
4. Do you think generative AI should be taught in schools?

- Yes
- No

5. If yes, why? If no, why?

Question regarding the website:

6. Would you like to know more about generative AI?
7. If yes, what would you like to know? If no, why not?

Introduction lesson concept and website:
In collaboration with Christelijk Lyceum Delft, a lesson concept and accompanying website have been developed for teachers. The aim of both the lesson concept and the website is to efficiently convey essential information about generative AI to students and teachers, without requiring too much time for teachers.

The aim of the lesson concept is to promote the conscious use of generative artificial intelligence (AI) among students by providing them with essential information about this technology. Moreover, the lesson concept facilitates as a tool to improve students' skills with generative AI.

The aim of the website is to provide teachers with easy access to essential information about generative AI. The website also contains short assignments that allow teachers to try out generative AI. Some of these assignments have been tested with students and can be used in the teaching concept.

If you would like to get access to one of these, please state which one and leave your email address.

L.5. Limitations

The majority of teachers who responded to the survey had used ChatGPT and none of them expressed a negative attitude towards it. This results in a one-sided perspective presented by the survey. However, as our current focus is on targeting teachers with an interest in ChatGPT, this is not considered a limitation at this time. Nevertheless, for further research it is preferable to measure the level of interest in the lesson module and website among a wider audience.

Appendix M - Evaluation of website through survey

M.1. Research goal

The aim is to assess whether the site adequately meets the needs of teachers, is sufficient in terms of usability, and provides teachers with valuable insights into Generative AI.

M.2. Research questions

1. Does the site meet teachers' needs?
2. Is the website sufficient in terms of usability?
3. Are teachers learning about Generative AI through the website?

M.3. Data collection

Data will be collected through a survey. This survey will contain open and closed questions. This survey will be shared through an email.

M.4. Participant recruitment

In a previous survey, 18 teachers mentioned wanting to get access to the website. Therefore, they were sent the link to the website with a request to fill in the survey. Nine teachers replied to the survey. Table A.11 shows the characteristics of the teachers. As the Table shows, the site was evaluated by a wide range of teachers. Only 1 teacher stated that they were not interested in Generative AI. While most teachers were positive about Generative AI, they were also hesitant about certain aspects of Generative AI. These aspects included sustainability concerns, ethical dilemmas and the spread of misinformation through Generative AI.

Characteristics	# of teachers
ChatGPT interest	
Positive and sees possibilities	1
Positive but hesitant	5
Interested, but not convinced yet	2
Not interested	1
Age of students they teach	
Junior	2
Senior	4
Junior & Senior	3
Subject they teach	
Geography	2
Biology	2
Science	2
Religions	1
Dutch	2
Gender	
Male	4
Female	5
Total number of teachers	9

Table A.11: Overview of teachers interviewed

M.5. Method

M.5.1. Methods used in the survey

The survey began by asking for background information about the teachers, and included open-ended questions to understand what aspects of the website interested teachers. The survey explains that information that can be traced back to them will not be used in this project.
It also asked whether teachers had gained any knowledge about Generative AI from the platform. Teachers were also asked if they were missing anything on the website.
To assess the usability of the website, the Sustainability Usability Scale is added. This is a post-test assessment created by John Brooke to measure how easy a product is to use (1986). It contains 10 statements and teachers can indicate how much they agree with the statements on a scale of 1 (Absolutely disagree) to 5 (Absolutely agree). All the questions in the survey are listed below. The questions have been translated into English. The questions were presented to the teachers in Dutch.

M.5.2. Questions

Hello, thank you for taking part in this survey. With your feedback, we can hopefully come up with something great that will benefit the school. This survey will first ask you for some background information to understand how you view Generative AI. This information will not include your name. The survey consists of some open questions and some closed questions.

Background information

1. Can you briefly write down which subject you teach and which classes you teach?
2. Can you briefly write down your views on Generative AI (think ChatGPT)?

Open questions to determine what areas of the website interest teachers

In this section, I would like to ask you to write down what your experience with the website was. You could find the following things:

- Learning about generative AI
- Trying out generative AI
- A teaching concept for teaching students about generative AI
- Tips on misuse with students

3. What is your take on the website?
4. Which parts of the website did you look at? Choose:
    a. Learning about generative AI
    b. Trying out generative AI
    c. A teaching concept for teaching students about generative AI
    d. Tips on misuse with students

Open questions to determine if teachers learned about Generative AI through the website

5. Did you learn anything from the website? If so: what?
6. Do you now know more about Generative AI through the website? If so, what?

Open questions to determine whether teachers are missing anything on the website

7. Are there parts of the website that you preferred over other parts?
8. Are there parts redundant on the website? Or, on the contrary, are there parts that are missing?
9. Is there anything else you want to say?

Sustainability usability questions using a scale from 1-5. 1 meaning 'absolutely disagree', 5 meaning 'absolutely agree'

In this section, you will find 10 statements about the concept. You can indicate how much you agree with the statements on a scale of 1 to 5.

10. I think that I would like to use this system frequently.
11. I found the system unnecessarily complex.
12. I thought the system was easy to use.
13. I think that I would need the support of a technical person to be able to use this system.
14. I found the various functions in this system were well integrated.
15. I thought there was too much inconsistency in this system.
16. I would imagine that most people would learn to use this system very quickly.
17. I found the system very cumbersome to use.
18. I felt very confident using the system.
19. I needed to learn a lot of things before I could get going with this system.

M.6. Limitations

Only nine teachers participated in the survey, which may limit the insights into usability. More participants will be needed to gain a better understanding. Furthermore, as a survey was used, it was not possible to assess the digital skills of the teachers, which could potentially influence the results of the survey.

Appendix N - Implementation and promotion of website

N.1. Research goal

This research aims to identify what is needed for teachers to start using the website and to develop strategies for its successful launch and promotion, to achieve sustained engagement and impact.

N.2. Research question

What do teachers need to use the website effectively, and how can it be launched and promoted for sustained engagement and impact?

N.3. Data collection

Semi-structured interviews will be used to explore the research question. A summary sheet will be used during the interviews to o visually present specific questions to the teachers and capture their teachers' responses. This sheet will also provide a basis for generating insights. See Figure A.11 for the sheet that will be used.

N.4. Location & set-up

Semi-structured interviews will be used to explore the research question. A summary sheet will be used during the interviews to o visually present specific questions to the teachers and capture their teachers' responses. This sheet will also provide a basis for generating insights. See Figure A.11 for the sheet that will be used.

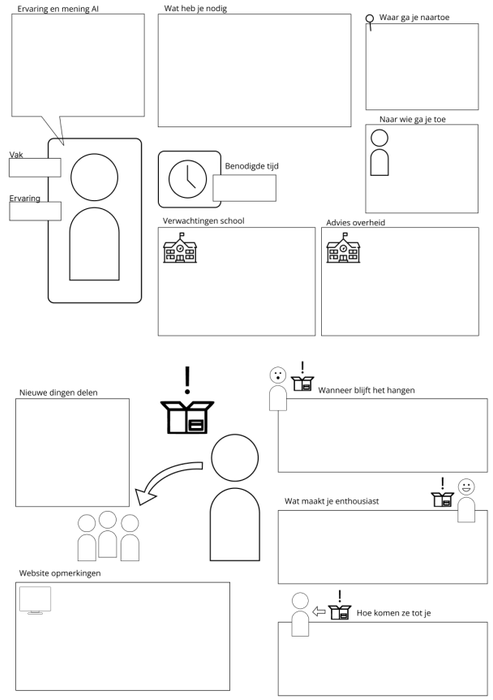


Figure A.11: Summary sheet that is used to write down answers of teachers during interviews

N.5. Participants

Three teachers from Christelijk Lyceum Delft volunteered to take part in discussions about the website and its promotion. These teachers correspond with the target audience of the website, as they have little to no experience with Generative AI. Furthermore, as they have not yet visited the website, their answers will reflect their current knowledge and provide an opportunity to think about effective promotion strategies for the website. Table A.12 provides an overview of the subjects taught by these teachers and the length of their teaching experience.

Characteristics	# of teachers
ChatGPT experience	
Has used ChatGPT 1-3 times	1
No ChatGPT experience	2
ChatGPT attitude	
Positive	2
Neutral	1
Subject they teach	
Biology	1
Dutch	2
Gender	
Male	1
Female	2
Total	3

Table A.12: Overviews of teachers who participated in the interviews

N.6. Method

Script
Introduction of myself
Consent form

Getting a general understanding of their attitude towards Generative AI
1. What is your experience with ChatGPT?
2. What do you know about Generative AI?
3. What do you think about Generative AI at school?
4. What do you think of using Generative AI for work?
5. What do you think of students using Generative AI?

SLO learning objectives (print out and take away)
Explain what the new draft learning objectives are and that they incorporate AI. Show draft learning objectives on paper.

6. What are your thoughts on SLO's current regulations?
7. Imagine AI would be implemented at school. What would your initial reaction be and how would you deal with this?
8. How do you feel about the idea of integrating AI into your subject?
9. What factors would motivate you to start using AI within your profession?
10. What do you think is the potential of AI within your field?
11. Imagine you need to integrate AI into your profession, can you describe how you would approach this?

Support:
12. How much time do you think you need to practice AI sufficiently before you can explain it to students?
13. What do you need to be able to explain Generative AI to students?
14. Where would you look for information about Generative AI?
15. What are your expectations from the school when AI is introduced as a new learning objective? (What do you need from the school?)
16. Where do you go about the questions about Generative AI?
17. Who do you go to for support in Generative AI?

Enthusiasm:
18. Are you open to new developments at the school? For example, new curriculum developments?
19. What does it take for you to be open to trying something new?
20. How do you know when new developments have really stuck with you, perhaps to the extent that you revisit them?
21. When it comes to new developments/ lessons, what do you get excited about? What are the things you dwell on for longer?
22. In what ways do these new developments/lessons reach you?
23. Suppose you are enthusiastic about a new development/teaching method, do you share this with others?
24. How do you share this with others?

Advice:
25. As advice to the government, what would you recommend regarding AI in education?

Website:
Showing website
A website has been developed with the help of the school, you may view it now.

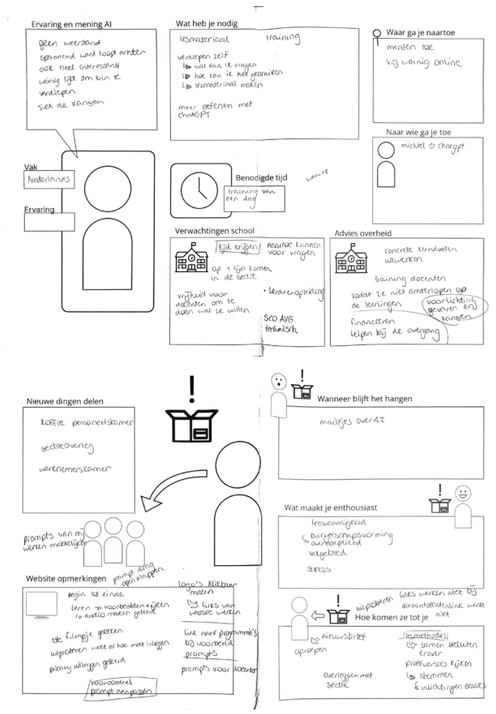
Observe: Seeing what they click on first, what interests them

26. What do you think of it?
27. What would you do with it?
28. What would need to happen to make you return to the website?

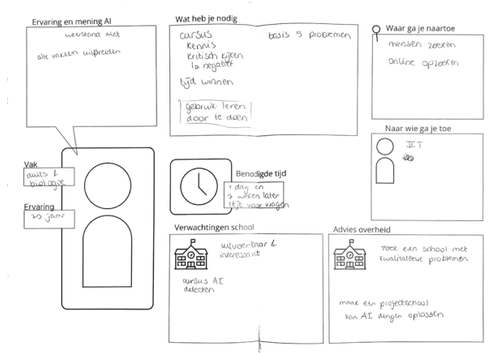
Explain purpose of website if necessary

N.7. Outcomes

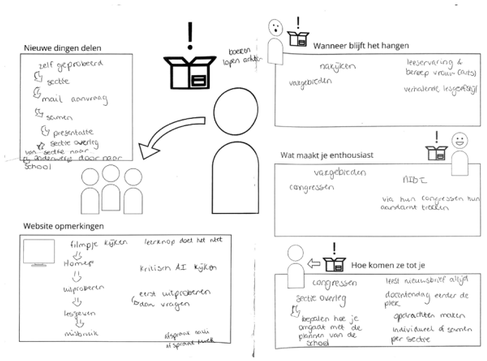
Participant 1



Participant 2



Participant 3



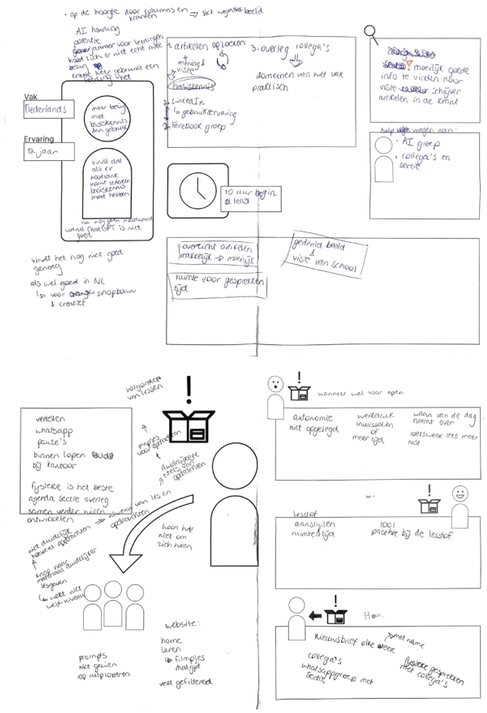


Figure A.12: Summary sheets with input of teachers

N.8. Limitations

Only three teachers were interviewed, which limits the depth of the findings. More participants are needed to gain a fuller understanding. In addition, teachers with negative attitudes towards generative AI were not interviewed, so their perspectives are not represented in the findings.

IDE Master Graduation Project

Project team, procedural checks and Personal Project Brief

In this document the agreements made between student and supervisory team about the student's IDE Master Graduation Project are set out. This document may also include involvement of an external client, however does not cover any legal matters student and client (might) agree upon. Next to that, this document facilitates the required procedural checks:

- Student defines the team, what the student is going to do/deliver and how that will come about
- Chair of the supervisory team signs, to formally approve the project's setup / Project brief
- SSC E&SA (Shared Service Centre, Education & Student Affairs) report on the student's registration and study progress
- IDE's Board of Examiners confirms the proposed supervisory team on their eligibility, and whether the student is allowed to start the Graduation Project

STUDENT DATA & MASTER PROGRAMME

Complete all fields and indicate which master(s) you are in

Family name	Tamsma
Initials	J.J.
Given name	Jeltje
Student number	4662628

IDE master(s) IPD ☐ DfI ✔ SPD ☐

2nd non-IDE master

Individual programme *(date of approval)*

Medisign ☐

HPM ☐

SUPERVISORY TEAM

Fill in he required information of supervisory team members. If applicable, company mentor is added as 2nd mentor

Chair	Nazli Cila	dept./section	HCID
mentor	Derek Lomas	dept./section	DA
2nd mentor	Michiel van Zomeren		
client:	Christelijk Lyceum Delft		
city:	Delft	country:	The Netherlands
optional comments			

! Ensure a heterogeneous team. In case you wish to include team members from the same section, explain why.

! Chair should request the IDE Board of Examiners for approval when a non-IDE mentor is proposed. Include CV and motivation letter.

! 2nd mentor only applies when a client is involved.

APPROVAL OF CHAIR on PROJECT PROPOSAL / PROJECT BRIEF -> to be filled in **by the Chair** of the supervisory team

Sign for approval (Chair)

Nazli Cila - IO — Digitally signed by Nazli Cila - IO Date: 2023.10.04 11:45:39 +02'00'

Name Nazli Cila Date 4 Oct 2023 Signature Nazli Cila

CHECK ON STUDY PROGRESS

To be filled in **by SSC E&SA** (Shared Service Centre, Education & Student Affairs), after approval of the project brief by the chair.
The study progress will be checked for a 2nd time just before the green light meeting.

Master electives no. of EC accumulated in total ____ EC

Of which, taking conditional requirements into account, can be part of the exam programme ____ EC

★	**YES**	all 1st year master courses passed
	NO	missing 1st year courses

Comments:

Sign for approval (SSC E&SA)

Robin den Braber — Digitaal ondertekend door Robin den Braber Datum: 2023.10.11 08:21:52 +02'00'

Name Robin den Braber Date 11-10-2023 Signature

APPROVAL OF BOARD OF EXAMINERS IDE on SUPERVISORY TEAM -> to be checked and filled in by IDE's Board of Examiners

Does the composition of the Supervisory Team comply with regulations?

YES	★	Supervisory Team approved
NO		Supervisory Team not approved

Comments:

Based on study progress, students is ...

★	**ALLOWED** to start the graduation project
	NOT allowed to start the graduation project

Comments:

Sign for approval (BoEx)

Monique von Morgen — Digitally signed by Monique von Morgen Date: 2023.10.11 10:10:50 +02'00'

Name Monique von Morgen Date 11/10/2023 Signature

Personal Project Brief – IDE Master Graduation Project

Name student Jeltje Tamsma **Student number** 4662628

PROJECT TITLE, INTRODUCTION, PROBLEM DEFINITION and ASSIGNMENT

Complete all fields, keep information clear, specific and concise

Project title Designing for the future of high school education

Please state the title of your graduation project (above). Keep the title compact and simple. Do not use abbreviations. The remainder of this document allows you to define and clarify your graduation project.

Introduction

Describe the context of your project here; What is the domain in which your project takes place? Who are the main stakeholders and what interests are at stake? Describe the opportunities (and limitations) in this domain to better serve the stakeholder interests. (max 250 words)

ChatGPT has emerged as a prominent subject of discussion in the field of education. In politics, ministers are discussing the impact they believe AI like ChatGPT will have on education. Next to that, the cabinet will make 80 million euros available for the National Educationlab AI and teachers can participate in projects about using AI in a good way in education (NOS, 2023). The politics states that it is up to the teachers to think of a way to go about this in education.

On high schools, a small number of teachers are actively advocating ChatGPT in creating homework assignments for students. Nevertheless, most high school teachers have not used ChatGPT whatsoever and their only source of information regarding ChatGPT is what they have read in news reports (Robert Lock). This news is mostly negative, which makes them hesitant on the use of it at school and afraid of a negative impact. Meanwhile, students are using tools like ChatGPT to help them with their studies. In high schools, students admit to using ChatGPT to write full reports for them (Schellevis & Moerland, 2023). So, schools and universities are obligated to think about how they will go about the use of it. High school teachers face the challenge of keeping pace with their students.

The stakeholders involved in the use of ChatGPT in education are the members of boards like SCO Delft that write the policies for high schools to follow. They need to come up with a plan and fitting policies around AI. The principal of the high school is involved and responsible for practicing and applying all AI policies and the teachers need to adhere to them.

NL AI Coalitie. (2022, February 23). Onderwijs - Nederlandse AI coalitie. Nederlandse AI Coalitie. https://nlaic.com/toepassingsgebied/onderwijs/ NOS. (2023, March 31). Nederland tegen strengere regels ChatGPT, schoolopdracht beter met "pen en papier."

➔ *space available for images / figures on next page*

Personal Project Brief – IDE Master Graduation Project

Problem Definition

What problem do you want to solve in the context described in the introduction, and within the available time frame of 100 working days? (= Master Graduation Project of 30 EC). What opportunities do you see to create added value for the described stakeholders? Substantiate your choice.
(max 200 words)

ChatGPT is a new and unsure thing and high schools are trying to navigate how to go about it (Schellevis & Moerland, 2023). As an example, Lucas Onderwijs is making a training to teach teachers about AI. Secondly, the Dutch AI coalition is looking into how they could create personalised education for students (NL AI Coalitie, 2022).

Even though I believe it is good to try to think of how to use ChatGPT to our advantage in education, I also believe that one should take a moment to discuss it with the ones that will have to work with it. In a chat with a teacher, she told me that she feels reluctant towards ChatGPT and judges her younger colleagues for using it to prepare classes. Robert Lock even mentioned that most teachers are not even aware of what AI means. Teachers are not ready to implement ChatGPT in class. However, they will have to do so quickly as they are falling behind with their students,

Robert Lock - Chair of SCO Delft

Schellevis, J., & Moerland, S. (2023, January 16). ChatGPT glipt langs docenten: "Ik gebruik het om snel huiswerk te maken." NOS. https://nos.nl/artikel/2460020-chatgpt-glipt-langs-docenten-ik-gebruik-het-om-snel-

Assignment

This is the most important part of the project brief because it will give a clear direction of what you are heading for. Formulate an assignment to yourself regarding what you expect to deliver as result at the end of your project. (1 sentence) As you graduate as an industrial design engineer, your assignment will start with a verb (Design/Investigate/Validate/Create), and you may use the green text format:

Envisioning the Future of High Schools and enhancing High School Teaching with ChatGPT-Driven Design

Then explain your project approach to carrying out your graduation project and what research and design methods you plan to use to generate your design solution (max 150 words)

By using the VIP method, I want to explore what the future of education should look like for teachers. Based on interviews with relevant stakeholders, trends, developments and the input of teachers I would like to design something that will help them embark this future. Based on this future, a possible outcome of the project could be a tool designed to guide teachers in the usage of AI. As ChatGPT is an online presence I predict that my design will take place online as well.

Research question:
What could the future of education look like for high schools teachers if ChatGPT is present?
- What is the current use, knowledge and developments of ChatGPT at school?
- What is the teacher' view on ChatGPT?

Design question:
How can we design for the future of education where high school teachers are adapted to ChatGPT?
- What skills do teachers need to effectively use ChatGPT at school?

Project planning and key moments

*To make visible how you plan to spend your time, you must make a planning for the full project. You are advised to use a Gantt chart format to show the different phases of your project, deliverables you have in mind, meetings and in-between deadlines. Keep in mind that all activities should fit within the given run time of 100 working days. Your planning should include a **kick-off meeting**, **mid-term evaluation meeting**, **green light meeting** and **graduation ceremony**. Please indicate periods of part-time activities and/or periods of not spending time on your graduation project, if any (for instance because of holidays or parallel course activities).*

Make sure to attach the full plan to this project brief.
The four key moment dates must be filled in below

Kick off meeting	02-10-2023
Mid-term evaluation	07-12-2023
Green light meeting	29-02-2024
Graduation ceremony	11-04-2024

In exceptional cases (part of) the Graduation Project may need to be scheduled part-time. Indicate here if such applies to your project

Part of project scheduled part-time	
For how many project weeks	
Number of project days per week	

Comments:
I will be doing my graduation for 4 days a week

Motivation and personal ambitions

Explain why you wish to start this project, what competencies you want to prove or develop (e.g. competencies acquired in your MSc programme, electives, extra-curricular activities or other).

Optionally, describe whether you have some personal learning ambitions which you explicitly want to address in this project, on top of the learning objectives of the Graduation Project itself. You might think of e.g. acquiring in depth knowledge on a specific subject, broadening your competencies or experimenting with a specific tool or methodology. Personal learning ambitions are limited to a maximum number of five.
(200 words max)

I believe that we should learn how to go about the usage of generative AI at school, instead of trying to forbid it. As generative AI is new and there is relatively little experience, I believe design will play a crucial role of guidance throughout the project. Design methods like VIP can help with thinking how to go about this new concept.

Throughout my master I was always drawn to AI, so I am eager to focus my graduation project on this topic. I am motivated to learn more about generative AI and what it could mean for the future.

I tend to overthink and stress, which is something I want to work at during my graduation project. The biggest achievement for me would be to feel proud with what I present in April. For this, I need to take time to reflect on things during my project and try not to rush things (which is something I tend to do).

Next to that, I'm really excited to do co-creation sessions with the teachers. I believe I can learn a lot from this experience and hope to get advise on these from my supervisors.