

A person is holding a glowing green egg-shaped object in their hands. The background is a blurred outdoor setting with a wooden deck and a black railing. The overall tone is dark and moody.

# ● Ask Poppy

Curiosity Beyond  
Classrooms & Screens

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2024

Field of Study  
Interaction Design

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# Summary

A persistent problem in education is unequal access to homework support. Lack of support mainly affects students from lower socioeconomic backgrounds and thus hinders their academic progress.

Poppy is a voice interactive AI assistant designed to bridge this gap, providing personalized support for teenagers in middle school (ungdomsskole).

Poppy targets the age group 12-16 due to their unique developmental challenges, including transitioning to abstract thinking and increased academic pressure. By utilizing the power of Large Language Models (LLMs) and a dedicated voice interface, Poppy offers a distraction-free, engaging learning experience that promotes critical thinking, communication skills, and independent learning.

Poppy is built on the principle of "necessary friction," encouraging students to actively participate in their learning journey. Rather than providing direct answers, Poppy guides students to articulate their thoughts, break down problems, and arrive at solutions independently. This approach fosters more profound understanding, vital communication skills, and confidence.

Through extensive research, including expert interviews, hands-on tutoring experience, and user testing, Poppy has been carefully designed to address teenagers' needs and challenges. The project prioritizes data privacy and ethical considerations, ensuring that Poppy is a responsible and valuable tool for students and educators.

Poppy has the potential to transform the homework experience, fostering a love of learning, empowering students to take ownership of their education, and contributing to a more equitable and inclusive educational landscape.



# Introduction

The field of education faces a broad range of complex and evolving challenges. In Norway, the quality of education is also influenced by several factors, including large class sizes, lack of teachers with relevant education, (Lærerkompetanse, 2022) and the socio-economic differences that impact family relations and educational outcomes (Hvordan påvirker foreldres utdanning og inntekt barnas karakterer?, 2022).

Homework aims to reinforce classroom learning and foster independent study habits but contributes to increased educational inequalities due to challenges faced by students lacking necessary support and resources (Rønning, 2011). Instead of looking at these strong negative emotions and challenges associated with homework as reasons to reduce or remove them, I'm looking for an opportunity to impact how students positively relate to homework.

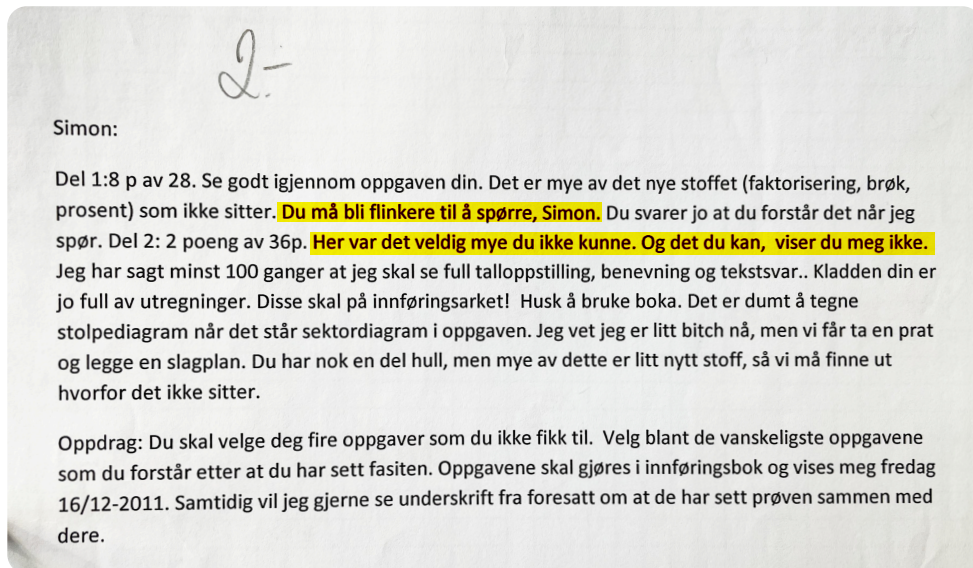
Homework serves as a possibility to address educational challenges through a personalized approach to learning. When conducted outside the structured classroom environment, homework can cater to individual learning needs and support each student's specific needs, learning pace, and personal interests.

The recent introduction of technologies like ChatGPT and a Large Language Model (LLM) points the way for exploring new solutions to bridge the support gap and empower students to take control and enjoy their learning journey.



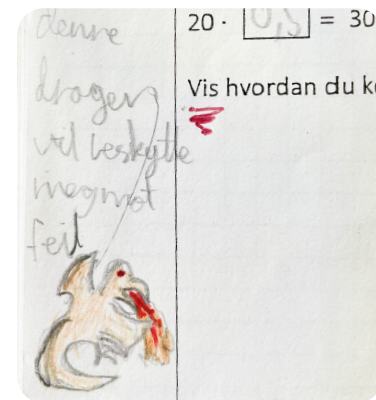
# Personal Motivation

A disconnect between understanding and communication marked my educational journey. I could grasp concepts quickly but struggled to express my knowledge in traditional academic formats, leading to underestimation by teachers and unsatisfying learning opportunities. This experience highlighted the limitations of standardized learning methods, which left me feeling misunderstood despite my curiosity and enthusiasm for learning. Fortunately, my path led me to study design at AHO, which was supported by technology, inspiring teachers, and my parents. Having both parents be curious, knowledgeable, and supportive, one of them being a pedagogical psychologist, gave me the encouragement and support I needed to follow my passions, a privilege many others may not have.



Feedback on my math-test from 9.th Grade

In 2022, I discovered how Large Language Models (LLMs) could tailor learning to individual interests and projects, which influenced the direction of my diploma. This project explores the broader impact outside just homework assistance, fostering a love of learning, encouraging curiosity and exploration, and enhancing communication skills. Poppy is built on learning to obtain knowledge actively rather than passively consuming it, providing users with a way to navigate the complexities of information and cultivate intellectual curiosity. As information becomes increasingly accessible through technology, the ability to ask the right questions becomes more important than finding the "right" answers.



"This dragon will protect me against mistakes"

# Curiosity Over Uniformity

Educational models have long focused on memorization and standardized tests, resembling the assembly line system introduced by Henry Ford in his factories to achieve efficiency and uniformity in production. This factory-like approach to education often constrains students' creativity and passion for learning. However, curiosity is crucial in fostering a love for learning and intellectual growth through personal and emotional relevance. When students are encouraged to explore topics that spark their interests and pose questions that fuel their desire to understand, the learning process becomes more engaging, meaningful, and ultimately more effective (Udir, 2021; von Stumm et al., 2011). Despite the recognized value of curiosity-driven learning, educational tools frequently fall short in supporting this organic development process due to either budgetary or technical limitations of technology.



Sagene School, Oslo 1930

Unknown photographer. (1902). "Et Klasserom". National Library of Norway. Retrieved 1. May 2024, from <https://www.nb.no/items/d2bedf95fde2f4baf325acf32fbec51?page=0&searchText=klasserom>

# Technology In Education

While technology offers alternatives for accessing information and additional learning resources, it also presents challenges. The abundance of distractions online and the passive nature of consuming information through screens can hinder students' ability to focus and engage in deep, meaningful learning (Pérez-Juárez et al., 2023). Exploring existing educational technologies, it is observed that they often prioritize structured learning pathways and predefined content, much like a digital version of a book, limiting opportunities for open-ended exploration and the pursuit of individual interests. Curiosity does not fit within the walls of a classroom or the bounds of a screen, or the budgets of the existing educational system.

However, the emergence of new technologies, particularly Large Language Models (LLMs), show a promising path for overcoming these limitations. LLMs, with their ability to process and understand natural language, offer a flexibility and adaptability that can be used when designing educational tools. Their capacity for generating text, translating languages, and answering open ended, challenging questions, opens doors for creating learning experiences that adapt to individual student interests and enable exploration beyond that of traditional curriculum. This potential for personalization and adaptability could lead to a new generation of educational tools that foster curiosity-driven learning and empower students to become active participants in shaping their educational journeys.

While exploring and researching this topic, I realized that interacting with LLMs has the potential to enhance students' learning experience by encouraging them to explore their interests and engage with information in a new way. This opens up endless possibilities beyond textbooks and applications. Although technology has limitations, Poppy is designed to complement and build upon the well-established foundation of conventional homework.

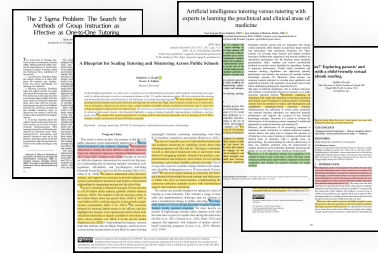


Rembrandt. (ca. 1634).  
A Scholar in His Study.

# Approach And Methods

My design process, driven by curiosity and user-centricity, uses the scientific method. This involves observing user interactions, testing hypotheses and refining, based on outcomes to uncover insights into educational challenges and user experience. The methods are not listed in chronological order, as various methods has been used in parallel.

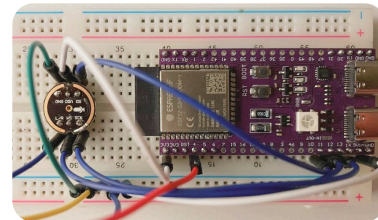
**Literature Review:** I reviewed academic literature on socioeconomic impact on education, tutoring and LLM's in personalized educational support.



**Field Research:** I explored Norway's homework support services, focusing on free alternatives, and engaged with Røde Kors stakeholders. I also gained hands-on tutoring experience at Tøyen public library.



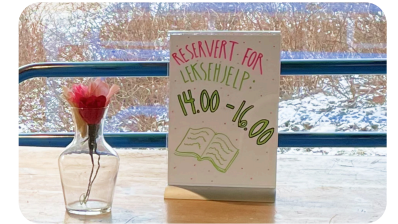
**Technological Feasibility Exploration:** I prototyped with text-to-speech technologies, ChatGPT, and microcontrollers to test technical feasibility and limitations.



**Expert Interviews:** Interviews with professionals in education, technology, psychology and design, provided insights into integrating AI in education.



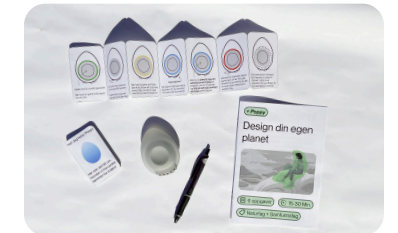
**Volunteer Tutoring:** A three-month volunteering experience as a homework tutor helped me understand student needs and limitations of existing practices.



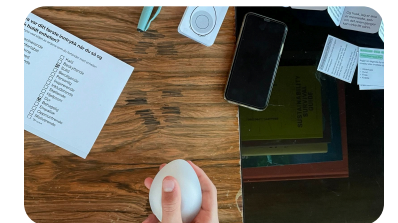
**Semi-Structured User Interviews:** I interviewed teachers, parents, and students to gather perspectives on homework challenges and desired features for Poppy.



**Prototyping:** I developed digital mockups, instructions, homework, physical prototypes, and custom ChatGPT chatbots to test interactions and tangible interfaces.



**User Testing:** Pilot tests and user-testing with teenagers refined Poppy's effectiveness, instructions, interface, and functionalities based on feedback





# Literature Review

The review addressed the socio-economic impact on educational performance, the benefits of tutoring, and the use of large language models (LLMs) for educational support.

**Socio-Economic Impact:** Educational outcomes are significantly influenced by socio-economic status, with students from lower-income backgrounds facing challenges like limited resources and higher school absence (Solomon & Lewis, 2002). Homework can strain family relations when parents struggle to assist, leading to negative associations with the act of doing homework (Pressman et al., 2015).

**Tutoring As a Method:** Studies show personalized tutoring significantly boosts academic performance and student well-being (Bloom, 1984). Scaling tutoring with human tutors has many implementation challenges, one of them being cost, estimated to \$5 to \$16 billion annually for state-wide implementation in the US (Kraft & Falken, 2021).

**Technological Advancements:** Advances in LLMs provide personalized, interactive learning experiences that are central to Poppy's design, aiming to enhance educational engagement and develop essential skills (Kasneci et al., 2023). These tools require further exploration to effectively support the cultivation of 21st-century skills like critical thinking, creativity, and collaboration (Yadav et al., 2023; Kuhlthau et al., 2015; Saavedra & Opfer, 2012)

The literature highlights the challenges of socio-economic disparities in education and the transformative potential of personalized tutoring and LLMs to address these issues.

“Parents’ concerns about their children’s futures create a climate of pressure to succeed as they support a homework agenda that is not necessarily their own and which they have little power to influence.”

(Solomon and Lewis, 2002, p. 17).

“The tutoring process demonstrates that most of the students do have the potential to reach this high level of learning.”

(Bloom, 1984, p. 7).

“Access to tutoring is inherently unequal. Private tutoring is a \$124 billion dollar industry globally”

(Kraft and Falken, 2021, p. 1)

# Target Users

Early adolescence (12-16) presents unique challenges due to rapid cognitive and emotional development, alongside transitioning to abstract thinking and complex problem-solving skills essential for interacting with AI technology like LLMs (Is ChatGPT Safe for All Ages?, 2024).

During this period, students face increased academic pressure and declining parental involvement, often intensified by the shift from primary to secondary school, where academic expectations rise and subjects diversify (Hill & Tyson, 2009).

As teenagers become more independent, parental guidance decreases, with schools recommending parents to step aside, potentially leaving gaps in support just as students require more guidance (Udir, 2021).

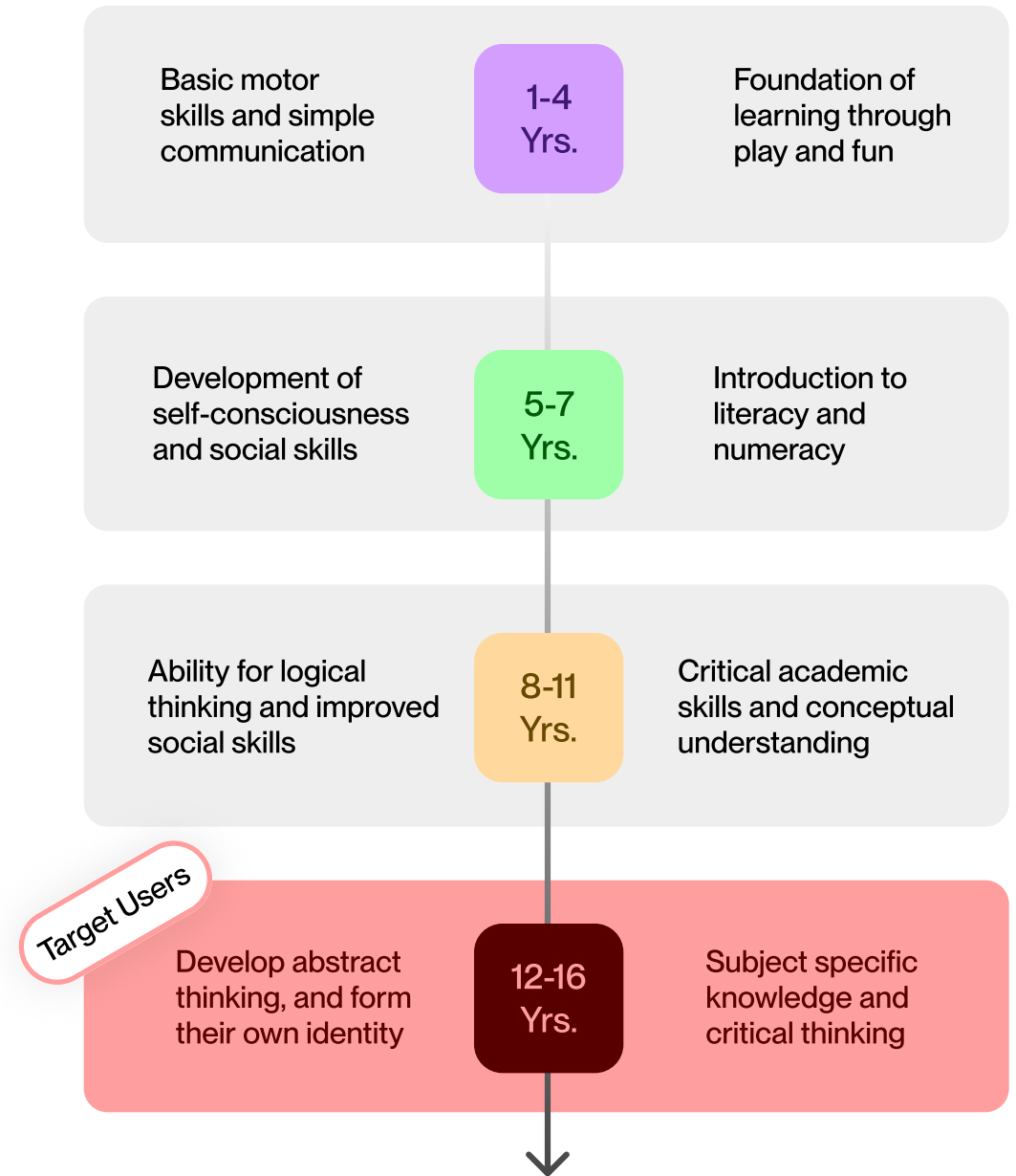
Poppy aims to fill this gap by providing flexible and supportive tools that cater to the evolving needs of adolescents, complementing the roles of parents and teachers, and aligning with their developmental trajectory towards independence.

Understanding these nuances was important when designing a learning support tool. Poppy's voice interface and conversational style aims to cater to teenagers' evolving cognitive abilities, promoting active listening, critical thinking, and communication skills.

Additionally, the design considers the emotional needs of teenagers, aiming to provide a sense of support, encouragement, and companionship during a period often marked by self-doubt and uncertainty for many.

## Mental Development

## Educational Progress



# Existing Solutions

Current homework support systems, despite good intentions, reveal a persistent gap in meeting students' diverse needs. Paid services are often too expensive, while free options struggle with limited reach and inconsistent quality. Even AI-powered digital platforms, delivering promising personalized learning, increase concerns about excessive screen time and the limited bounds of the technology and diminished human interaction.

Students need a solution that is both accessible and engaging, offering personalized support without increasing existing educational inequalities. Poppy aims to bridge this gap by combining the efficiency of AI with the human-centered approach of traditional tutoring. Through the use of voice interaction and a dedicated device, Poppy offers a balanced learning experience that promotes critical thinking, communication skills, and student motivation, regardless of their background or access to resources.

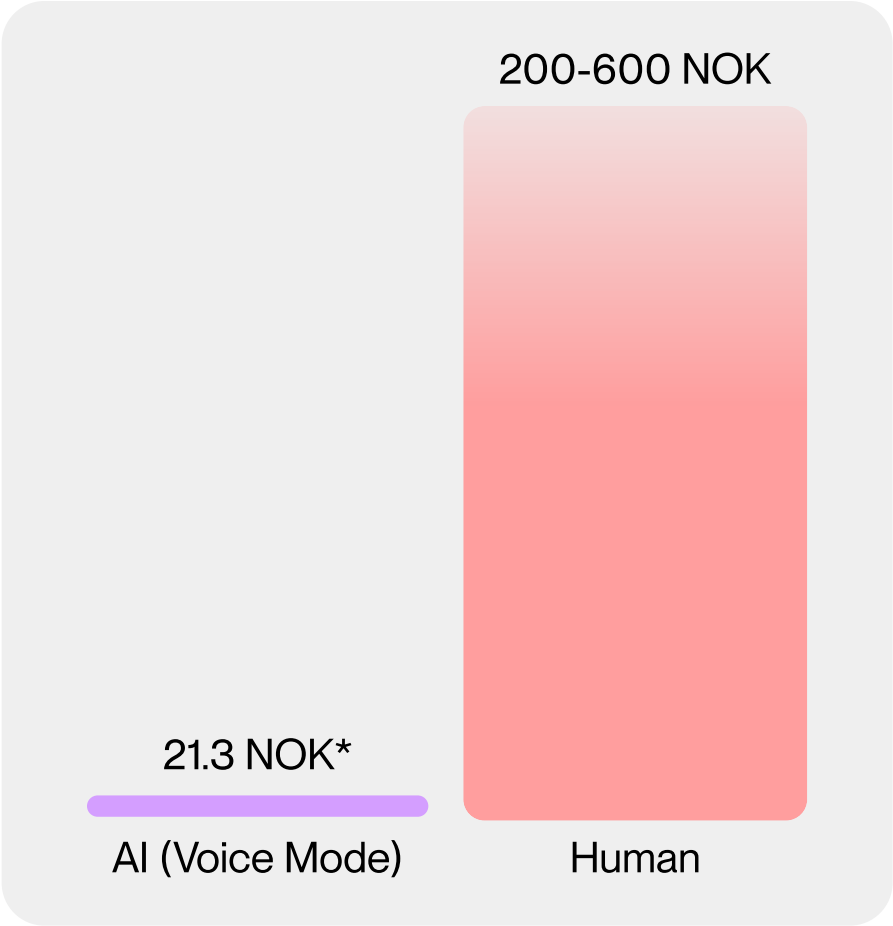
**Røde Kors**  
Digital Leksehjelp

**Digital Leksehjelp er nå stengt. Åpent mandag – torsdag, kl. 17.00 – 21.00.**

The advertisement features the Røde Kors logo and an illustration of a person sitting at a desk with a laptop, representing digital homework help.



## Human Tutor vs. AI tutor (Cost Per hour - 16 May 2024)



\*Cost based on OpenAI; Transcription (Whisper \$0.006/minute), Text Generation (GPT-4o Input: \$0.012/1K tokens, Output: \$0.016/1K tokens), Text To Speech (TTS \$0.015/1K characters, estimated spoken time: 30 minutes)

# Becoming a Tutor

To move beyond theoretical understanding, I volunteered as a homework tutor at a public library in Tøyen, working directly with elementary students. This experience provided insights into the social, emotional, and academic needs of a diverse group of children, revealing that their needs were multifaceted.

## Social Dynamic

Tutoring in a library setting highlighted the social aspect of learning, with students often working in groups and interacting with peers.

## Motivation Level

Student motivation varied significantly; some were eager and proactive, others procrastinated or avoided homework altogether.

## Distractions

The use of mobile devices and tablets frequently disrupted students' focus, affecting their ability to concentrate on homework.

## Learning Styles

There was a wide range of learning styles and paces; some students performed well with mental calculations while others benefited from more structured and visual guidance.

## Social Support

Asking about students' interests, fostered a positive learning environment which contributed to a sense of connection and belonging improving the tutoring.

## Confidence

Low confidence levels led some students to exhibit avoidance behaviors and a reluctance to seek help or feedback after completing tasks.

## Ask Questions

Open-ended questions effectively guided students towards solving problems independently, a strategy that informed the design of Poppy.

## Personalized

Tailoring support to individual needs was important for enhancing student engagement and success.

**Reflections and Conclusions:** The tutoring experience showed me the importance of open-ended questions and individualized support in supporting independent problem-solving and confidence among students. These insights directly influenced Poppy's development, focusing on understanding facilitation of the students' cognitive processes rather than direct problem-solving.

Observations on group dynamics and the necessity of building confidence shaped Poppy's approach to support students' emotional and social aspects of learning.

Additionally, the design of Poppy aims to integrate effectively within the technological landscape, using digital tools to enhance rather than distract from the learning experience. This practical grounding ensures that Poppy addresses real student needs and challenges, promoting engagement and independence in learning.

# Problem Statement and Hypothesis

## Problem Statement

Students need accessible and personalized assistance outside the classroom and school hours to succeed with their homework.

However, existing solutions such as parental support, paid tutoring services, or limited free tutoring options often prove inadequate or inaccessible, disproportionately disadvantaging children from lower socioeconomic backgrounds and hindering their academic progress and social mobility.

Additionally, the increasing reliance on digital learning platforms and screen-based tools raises concerns about excessive screen time, potential distractions, and the lack of a balanced learning experience.

## Hypothesis

If secondary school students have access to a personal support device during individual work that provides homework assistance through spoken conversations,

they are likely to achieve a better grasp of concepts and tasks,

while showing greater interest and satisfaction during learning activities, without the distractions of existing technology such as smartphones and tablets.



## Refined Hypothesis

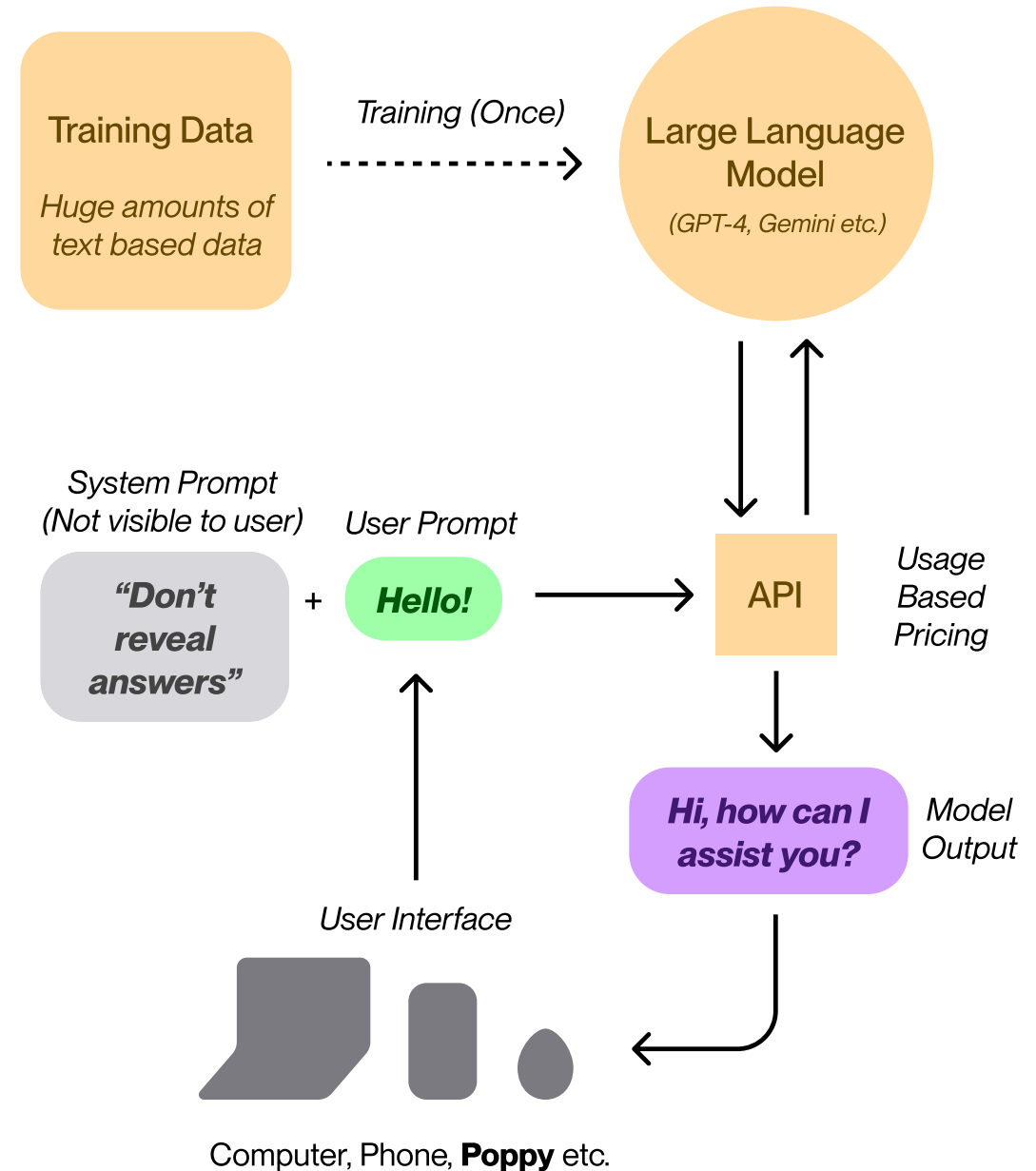
Providing early teens with a voice-interface AI assistant for personalized homework support will increase their engagement, confidence, and problem-solving skills, leading to a more positive learning experience and improved academic outcomes.

# Technological Potential

## Large Language Models

The emergence of Large Language Models (LLMs) marks a turning point in personalized education. Unlike previous AI approaches, LLMs understand and generate human-like text, enabling truly tailored learning experiences. By accessing LLMs through application programming interface (API), which allows limited access to these powerful models without needing to own or maintain them, we can integrate sophisticated AI capabilities into affordable, internet-connected devices like microcontrollers. Costing as little as \$5-\$15 these devices connect to LLMs hosted on remote servers. This enables AI-powered educational tools that are both cost-effective and capable of providing real-time, interactive learning experiences. This approach increases the likelihood for students, regardless of their socioeconomic background, to access high-quality educational support.

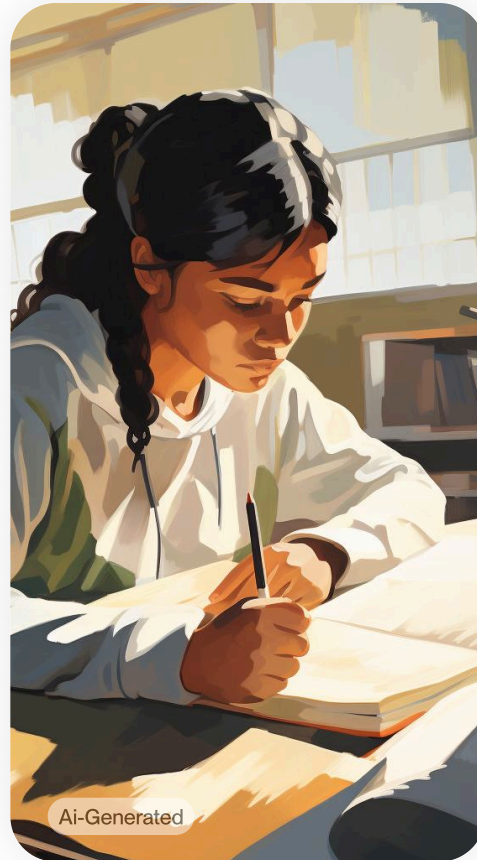
However, the way students interact with technology is just as important as the technology itself. Concerns around excessive screen time, expressed by both parents and experts, led to Poppy's focus on voice interaction.



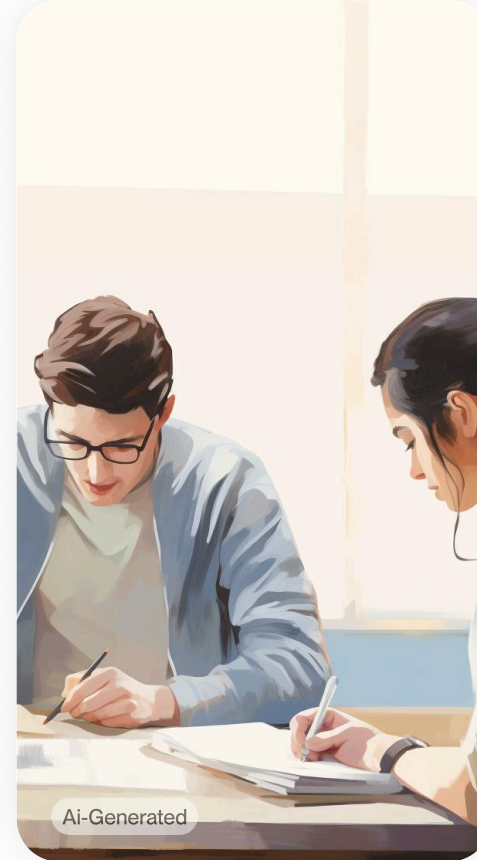
# Voice Interface



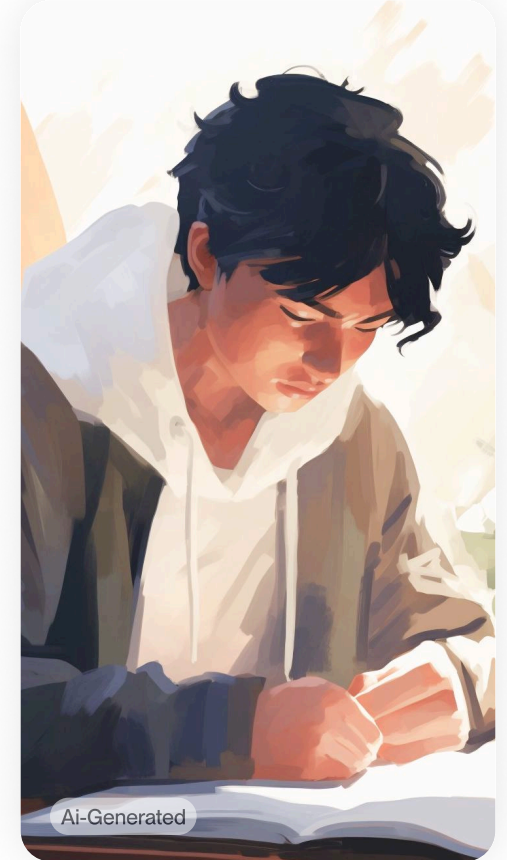
**Engagement Without Screens:** Voice eliminates screen fatigue, promoting focus and a more mindful learning experience.



**Cognitive Process:** Interacting through voice provides friction in the right places; encouraging active listening, clear articulation, and strengthens verbal communication skills.



**Familiar Interaction:** Voice mimics the familiar teacher-student dialogue, creating a comfortable learning environment that encourages active participation.



**Emotional Support:** While not replacing human interaction, a well-designed voice interface can provide a sense of companionship and motivation, leading to the user feeling heard, acknowledged and understood.

# Technical Feasibility Exploration

To ensure that the concept worked within the existing limitations of the technology, I explored the technical aspects of integrating LLMs and voice-interface on hardware devices. This exploration involved:

**Backend With Deno:** I used Deno, to build the backend between the OpenAI's API's and the hardware, managing the overall system logic, reducing the compute happening on the hardware to increase speed. ChatGPT assisted in generating code snippets, troubleshooting and debugging issues.

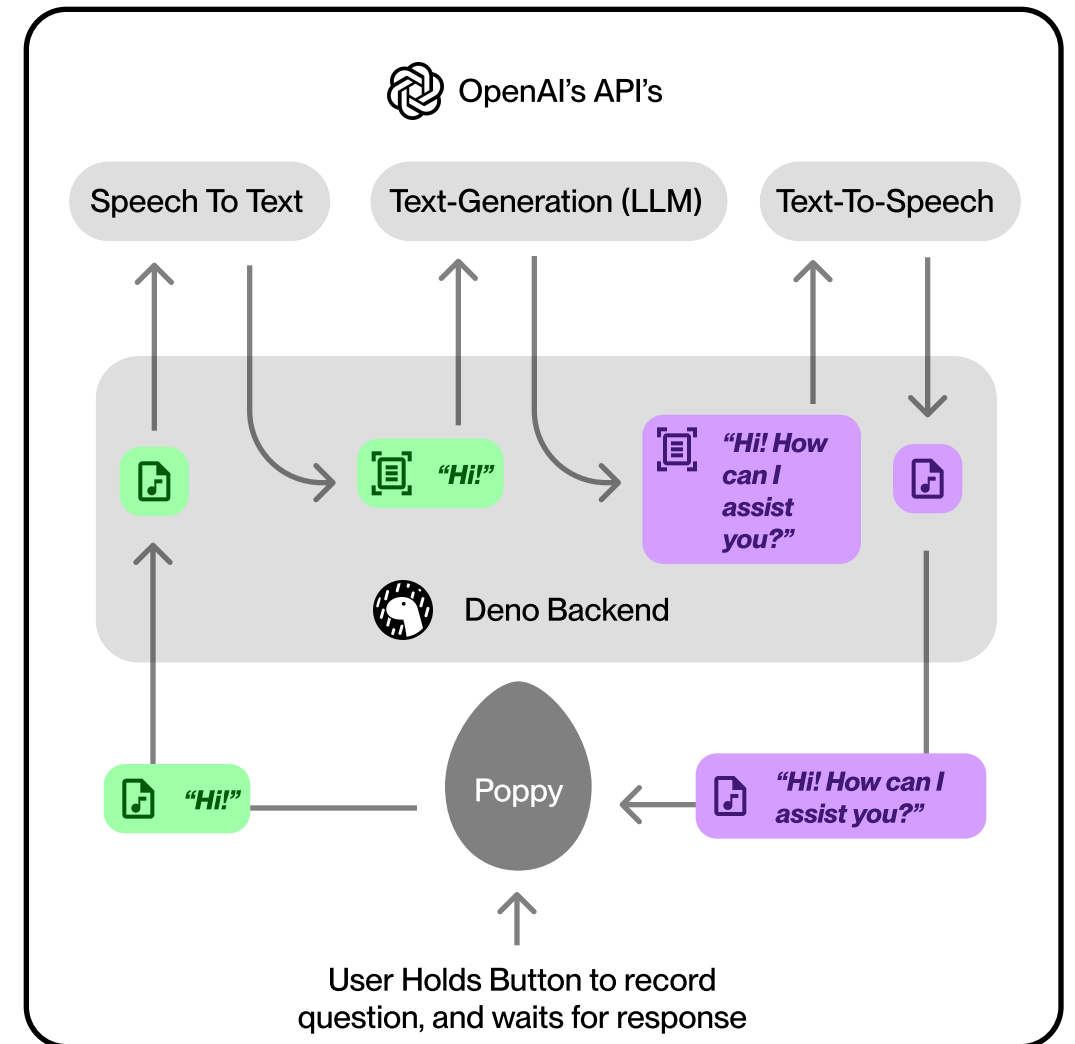
**OpenAI's API:** I used OpenAI's Assistants API as the chosen API, as it allows for custom behavior, similar to that prototyped in the ChatGPT app used for user-testing - which I've written more about in the "Pilot- and User-testing section"

**Text-to-Speech Solutions:** I explored various software services; such as ElevenLabs for its human-like text-to-speech capabilities, and I attempted to create a working device to user-test with kids. However, due to the lack of Norwegian language support and time constraints, I used the ChatGPT app on an iPhone during user testing to ensure accessibility using Norwegian language for the target audience, despite the American accent.

**Hardware Prototyping:** For the physical device, I prototyped using the ESP32-S3 microcontroller, programmed through the Arduino IDE. The prototype had components such as a microphone for capturing questions, an amplifier and speaker for audio output, a button for starting recording, and an LED for providing visual feedback.

**Videos of demo and tech process in Appendix: Tech Process**

## Poppy's Response Cycle



Integrating LLMs and voice interaction into a user-friendly device proved challenging, yet insightful. While I successfully built a functioning prototype, inconsistencies in real-world performance (loading times, response speeds, audio quality) highlighted crucial design considerations. These limitations informed my final design, ensuring Poppy is both technically feasible and provides a reliable user experience.

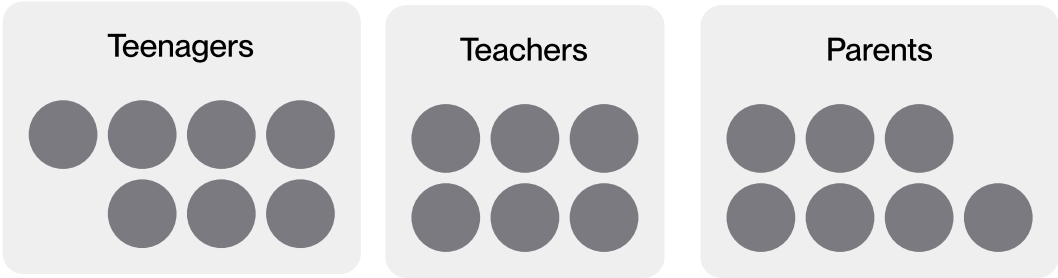


# User Research

## Interviews

Understanding the landscape of homework support and gathering insights from those most affected by it was crucial to the development of Poppy. To achieve this, a series of semi-structured interviews were conducted with key stakeholders representing diverse perspectives: subject matter experts in AI and education, teachers, parents, and the target users - teenagers themselves.

## Overview of People I've Talked With



### AI and Communication

- Erik Winerö  
University of Gothenburg
- Senior HCI Professor  
Psychology and Communication, NTNU
- Ethan Sutin  
Owl AI
- Sam Eaton  
Curio Beta
- Matt Webb  
Acts Not Facts

### Product Design + UX

- Niklas Schmidt  
Industrial Design
- Mona Kleven Lauritzen  
UX Lead, Huddly
- Bai Daniel Kanu  
Industrial Designer, Inventas
- Viktor Rydal  
Chief Design Officer, Nomono

### Education & Homework

- Janet Goulden Dreyer  
Educational Psychologist, PPT (My mom)
- Ada Aagre Pettersvold  
Senior Advisor, Fellesverket Majorstua
- Hannah Karlsen  
Project Lead, Neddy
- Hedda Jorde Ødegård  
Coordinator, Digital Leksehjelp

### Educational Technology Expert

- Ivar Berg  
Former Head of Google Education Norway

### Branding and Strategy

- Henrik Fjeldberg  
Digital Director, Heydays
- Benjamin Gaupset  
Designer, Heydays

### Gyldendal

- Kristin Tobiassen  
Lead UX/UI
- Miryam Pippich  
Senior Service Designer
- Lasse Høgås  
Educational Advisor
- Oskar Galewicz  
Senior Interaction Designer

## Subject Matter Experts 20

**Shifting Educational Landscape:** Erik Winerö emphasized the importance of adapting to the digital shift in education and the increasing integration of AI. He advocated for technology that enhances learning processes, directly informing Poppy's focus on process-oriented learning.

**Voice Interface as a Differentiator:** Both the Senior HCI Researcher from NTNU and Matt Webb highlighted the potential of a voice interface to reduce screen dependence, foster more natural interactions, and enhance communication skills.

**User Needs and Usability:** Experts stressed the importance of user-centered design and ethical considerations in AI development. Hanna Karlsen emphasized Poppy's need to be intuitive and responsive to user needs, while Erik Winerö urged a focus on responsible AI development that avoids exacerbating existing educational disparities..

**AI as a Teammate:** Matt Webb offered a forward-looking perspective, envisioning AI as a collaborative partner that reshapes learning and workplaces. This vision influenced Poppy's development to foster cooperative learning and critical skills necessary for future challenges.

“Every student can have a personal tutor with AI-powered tools.”

Senior Research at NTNU

“The school should not be built around the teacher, but the student.”

Hanna Karlsen (Neddy)

“We need to focus on technology that makes the learning process more important than the result.”

Erik Winerö

“Kids today are going into a world of work that is going to be powered by LLM's - How do we prepare them for that starting now?”

Matt Webb

## Teachers 6

Teachers expressed a range of experiences with technology in their classrooms, highlighting both the benefits and challenges of integration. They were generally receptive to the idea of a voice assistant like Poppy, recognizing its potential to assist students with homework, provide immediate feedback, and offer additional support outside of classroom hours.



**Technology in Education:** While some teachers embraced technology for interactive learning and personalized instruction, others expressed concerns about potential distractions and the importance of a balanced approach.

**Attitudes towards AI:** Opinions on AI in education varied. Some expressed enthusiasm for its potential to personalize learning, automate tasks, and provide additional support, while others raised concerns about ethical implications, potential job displacement, and the need for clear guidelines and training for responsible AI implementation.

**Feedback on Voice Assistant:** Teachers were generally receptive to the idea of a voice assistant like Poppy, recognizing its potential to assist students with homework, provide immediate feedback, and offer additional support outside of classroom hours.

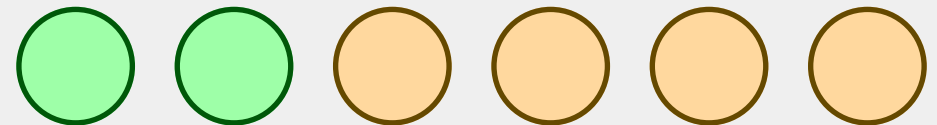
“A spoken conversation, I think, would change things a bit – when you receive it verbally and deliver it verbally – then it can change the interaction, you will gain some learning anyway if you reproduce it.”

9.th Grade teacher in English and Social Studies

“There is no point in asking students to produce a text. They can't help but cheat, it's hard to stay away from asking ChatGPT to just write the whole text.”

10th Grade teacher in Norwegian and Natural Science

### Teachers Interviewed



Elementary School  
(Grades 1-7)

Lower Secondary School  
(Grades 8-10)

## Parents 7

Parents acknowledged the increasing role of technology in their children's lives and education, expressing both excitement about the potential benefits and concern about the potential drawbacks.



**Technology Use and Expectations:** While recognizing the benefits of educational apps and online resources, parents raised concerns regarding excessive screen time, exposure to inappropriate content, and the potential for technology to hinder the development of essential skills like critical thinking and social interaction

**Supporting Children's Learning:** Views on Poppy were mixed. Some saw it as a potential relief, offering accessible support and easing pressure on both themselves and their children. Others expressed concerns about potential over-reliance on technology and emphasized the importance of maintaining their own engagement in their child's education.

**Privacy and Security Concerns:** Data privacy and security were concerns, with parents emphasizing the importance of transparency, control over data sharing, and robust security measures, especially related to recording of audio data of their child's voice.

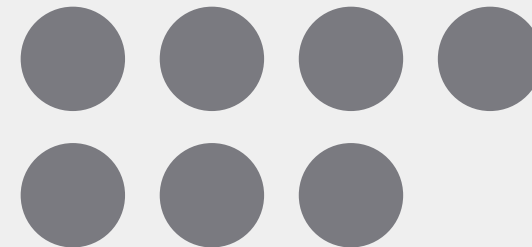
“If we get technology that is available to everyone and quality assured by someone reputable...for example, Gyldendal, then you trust it.”

Father of 14 year old

“Our children don't want help with their homework, they cry before they open the books...Helping with the homework is very difficult.”

Mother of three teenagers

### Parents Interviewed



## Target Users 7

Teenagers demonstrated diverse learning preferences and challenges. They responded positively to the concept of interacting with a voice assistant like Poppy, finding the conversational approach engaging and motivating.



**Learning Preferences and Challenges:** Teenagers favored various learning styles, including visual aids, interactive games, reading, and hands-on activities. Common homework challenges included difficulty understanding instructions, staying focused, and seeking help when stuck.

**Engagement and Motivation:** They appreciated Poppy's conversational approach, the ability to ask questions, and receive immediate feedback, which they found more engaging than traditional textbook-based learning.

**Desire for Personalized Support:** They expressed a desire for learning tools that adapt to their individual needs and pace. They saw value in Poppy's ability to provide personalized explanations, offer different approaches to problem-solving, and adjust its level of support based on their understanding.

“I do some homework when I have time... I can't do anything with books or writing by hand on the subway, everything I can do completely digital, I can do it on the subway, the bus.”

14 Year Old

“I usually ask my mom, or I skip it and ask the teacher - I've also asked ChatGPT - asked if it could explain the assignment in a different way – seems good and helps a lot.”

16 Year Old

“With homework – I get help from my mom, or ask for help on Teams, outside of school hours. Can send a message at 11 pm – 'Then I've tried what I can.'”

14 Year Old

### Kids Interviewed and their age

12

13

14

14

14

16

16

# Pilot- and User-Testing

To evaluate the feasibility and effectiveness of Poppy, a pilot test was conducted with five adults, followed by a more comprehensive user testing phase with seven teenagers. Due to challenges with Sikt and ensuring data privacy for children, the pilot test involved a small group of friends, while the user testing with teenagers involved preparatory interviews with their parents to understand the educational context and obtain consent.

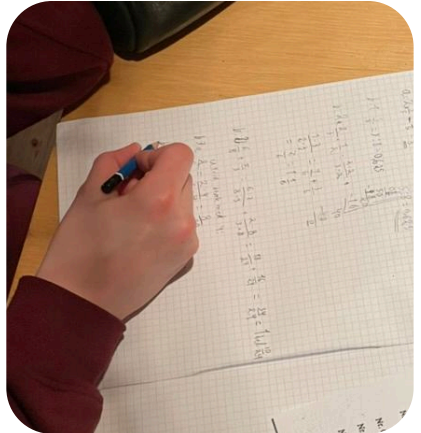
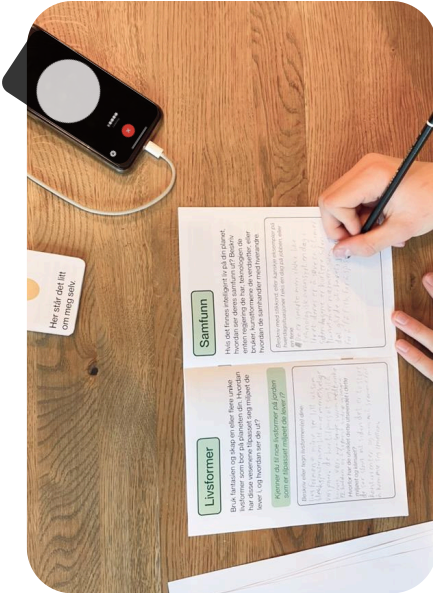
## Testing Setup and Tasks:

### Pilot Test

Adults simulated a homework scenario focused on the water cycle, using Poppy via the ChatGPT app's voice interface. This initial test aimed to evaluate concept feasibility and identify potential challenges

### User Testing with Teenagers:

Teenagers used Poppy, again via the ChatGPT app's voice interface, to complete actual school assignments provided by Gyldendal in their own homes. This setup aimed to simulate a natural learning environment and gain insights into Poppy's real-world utility. Non-functional physical prototypes were also tested during these user-tests to gauge ergonomic and style-preferences.

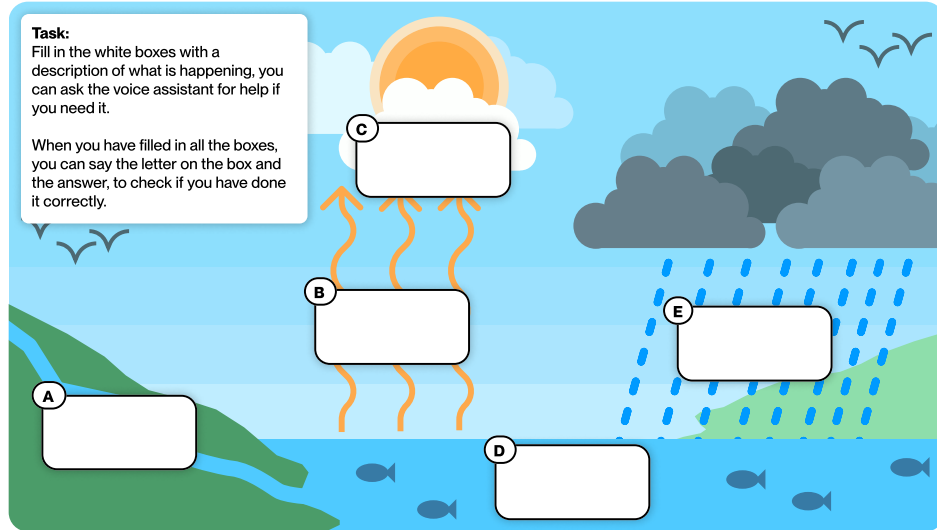


# Pilot Testing

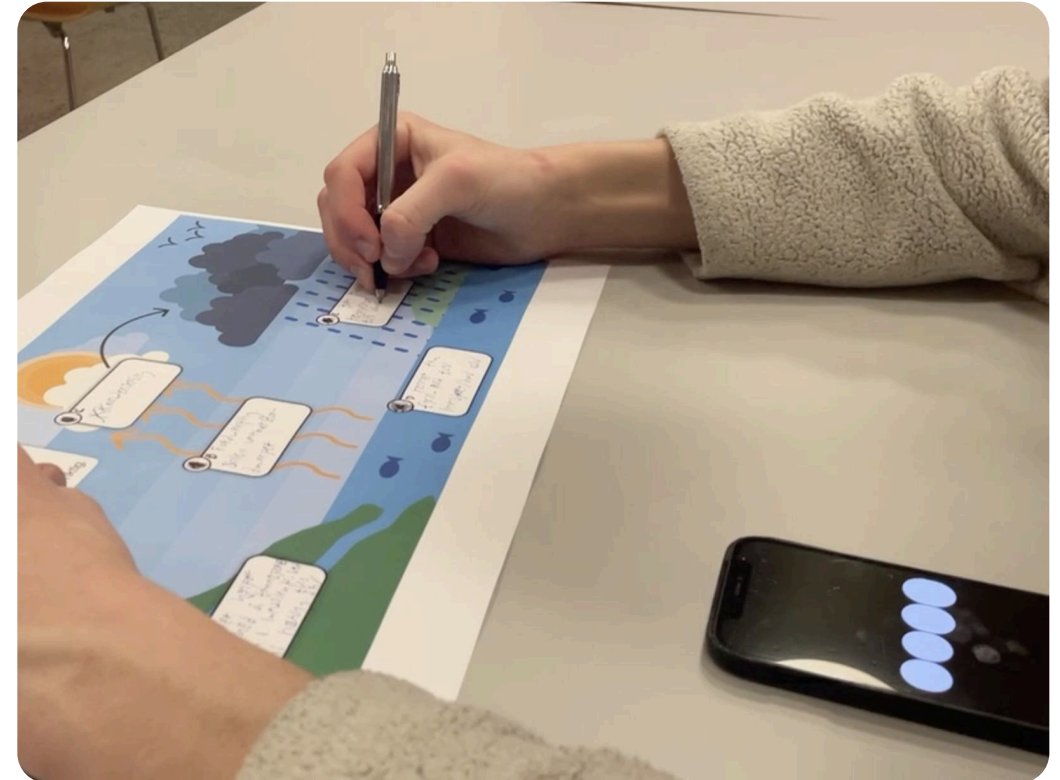
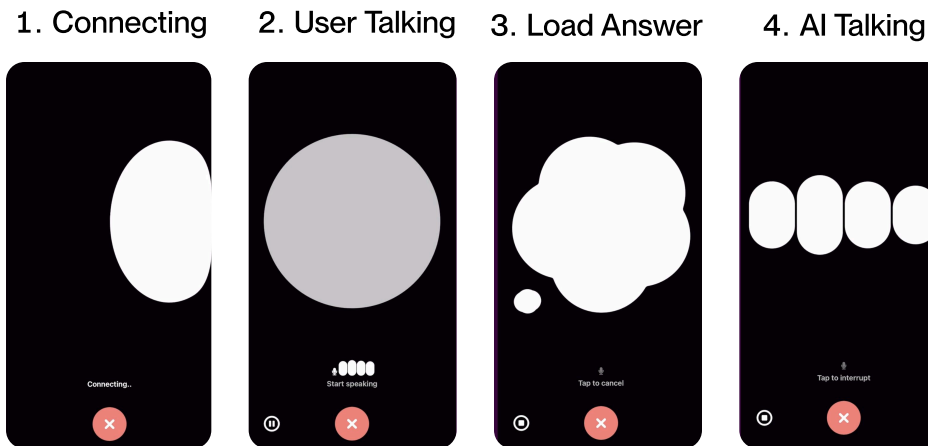
## Testing Setup

Initial tests involved five adults simulating a homework scenario to evaluate concept feasibility. The task focused users filling out a worksheet about the water cycle.

Homework task



ChatGPT Voice-mode



- Assistant was too helpful
- Information Overload
- Limited time for reflection

### Adaptations from Insights

Adaptations from Insights, including the decision to require students to explain the tasks themselves, led to changes in Poppy's conversational flow, emphasizing guiding students rather than providing direct answers. This approach ensured responses were concise and clear, improving students' auditory processing. These changes addressed the need for a pedagogically supportive communication flow, considering thinking time and response length.


# User Testing

Further testing involved seven teenagers, with preparatory interviews with their parents to understand the educational context. Testing typically occurred in the children's homes during homework time to maintain a consistent and realistic environment.

## Educational tasks provided by Gyldendal

**Hvor kommer energien fra og hvor blir den av?**

1. Forklar hvorfor solenergi er så viktig for livet på jorda



2 a. Hvilke ulike energikilder bruker vi mennesker til å lage elektrisk strøm?  
Skriv en faktasetning om hver av dem.

<b>Energikilder</b>	<b>Fakta</b>
<input type="text"/>	<input type="text"/>
<input type="text"/>	<input type="text"/>
<input type="text"/>	<input type="text"/>

2 b. Hvilke ulike energikilder bruker vi mennesker til transport?  
Skriv en faktasetning om hver av dem.

<b>Energikilder</b>	<b>Fakta</b>
<input type="text"/>	<input type="text"/>
<input type="text"/>	<input type="text"/>
<input type="text"/>	<input type="text"/>

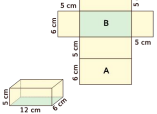
3. En datamaskin er drevet av elektrisk energi. Hvilke energiformer tror du den elektriske energien går over til etter at den har gjort jobben i datamaskinen, og hvor blir energien av til slutt?

**Algebra - Regning med måling**

Aah, I don't even know how to describe this to get help from Poppy.

Aah, I don't even know how to describe this to get help from Poppy.

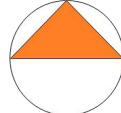
- 14 year old during user-testing  
- 14 year old during user-testing



Svar:

2. Diametren i sirkelen er 14 cm.  
Hva er arealet til trekanten?

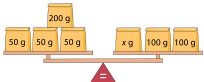
Oppgave-ID: GNF252528



Svar:

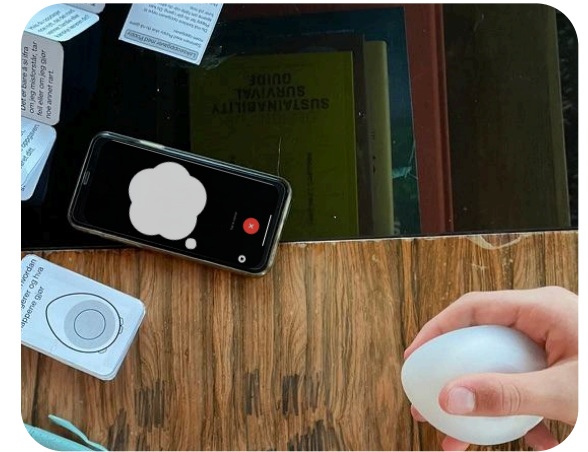
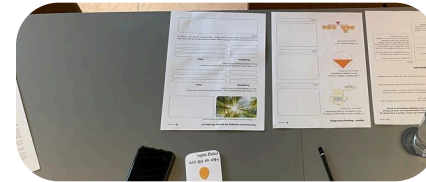
3. Hvilket tall står x for?

Oppgave-ID: GNF232316










Svar:

It was important to ensure that the tasks varied and could accommodate the age-range of the users - even though interactions with Poppy was the main focus of the test and not the performance of the student.

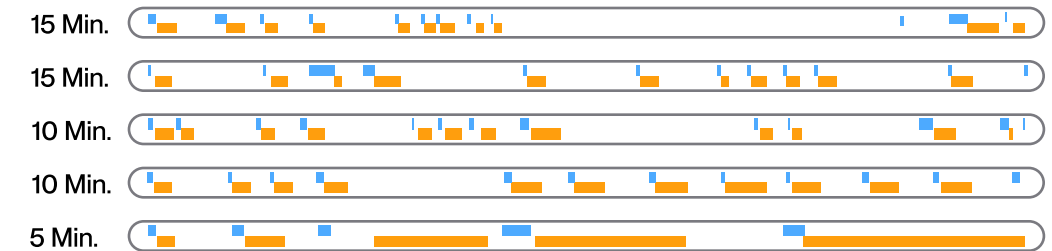


## Communication Guidelines For Users

<p><b>Conversation</b></p>  <p>I can help with homework, talk about things you wonder about, and answer questions.</p>	<p><b>Explain</b></p>  <p>I can't see, so you have to explain things well to me so I can help you.</p>	<p><b>Feedback</b></p>  <p>If you want feedback on your work, you can explain the task and what you have answered.</p>	<p><b>Be Critical</b></p>  <p>Let me know if I make a mistake or if I'm doing something else weird</p>	<p><b>Sharing</b></p>  <p>If you discover something new, share it with friends, family or maybe your teacher?</p>	<p><b>Machine</b></p>  <p>And remember, I'm not human, even if it can seem a bit like that sometimes.</p>	<p><b>Tell me!</b></p>  <p>My technology allows me to adapt to your needs, so let me know if you need anything!</p>
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## Interaction Duration Timeline

Only 5 user-sessions were recorded



This graph aims to visualize the relationships between the engagement of the user vs. Poppy - indicating that the user is more passive than desired.



## Key Findings from Testing

Testing with both adults and teenagers revealed valuable insights into the potential and challenges of voice interaction for personalized learning.

### Engaging, Yet Disruptive



While users found the conversational format intuitive and engaging, the turn-by-turn nature greatly disrupted their flow of thought, particularly during complex problem-solving. Users occasionally lost track of their reasoning or struggled to articulate complete thoughts within the constraints of turn-based dialogue.

### Promoting Articulation



Teenagers quickly adapted to the voice interface, appreciating its personalized nature and the opportunity for listening. The difficulty in articulating questions to Poppy changed to improved clarity and precision over time, showing the potential for voice interaction to improve communication skills. Users also valued Poppy's ability to accurately understand the context of their questions and provide relevant, concise responses, or ask questions if their original question was too vague.

### Feedback + Beyond Homework



Teenagers quickly adapted to the voice interface, appreciating its personalized nature and the opportunity for listening. The difficulty in articulating questions to Poppy changed to improved clarity and precision over time, showing the potential for voice interaction to improve communication skills. Users also valued Poppy's ability to accurately understand the context of their questions and provide relevant, concise responses, or ask questions if their original question was too vague.

Responses from ChatGPT/Poppy versions to the same question

How many degrees inside the following shapes?

Triangle, rhombus, circle, pentagon

#### ChatGPT (Control)

Here's the number of degrees inside each shape:

1. Triangle: The sum of the interior angles is  $180^\circ$ .
2. Rhombus: The sum of the interior angles of any quadrilateral is  $360^\circ$ . As a rhombus is a quadrilateral, it has  $360^\circ$ .
3. Circle: A circle is a continuous curve and doesn't have internal angles like polygons do. If you consider the whole circumference, you can think of it as a  $360^\circ$  rotation.
4. Pentagon: The sum of the interior angles of a polygon with  $n$  sides can be calculated using the formula  $(n-2) \times 180^\circ$ . For a pentagon ( $n=5$ ), the sum is  $(5-2) \times 180^\circ = 540^\circ$ .

#### Poppy (1st Iteration)

Here's how to calculate the number of degrees inside each of these shapes:

1. Triangle: A triangle always has a total of  $180$  degrees.
  2. Rhombus: A rhombus is a type of quadrilateral (four-sided figure), and like all quadrilaterals, it has  $360$  degrees in total.
  3. Circle: A circle encompasses  $360$  degrees around its center.
  4. Pentagon: A pentagon, which has five sides, can have its interior angles calculated using the formula for the sum of interior angles of a polygon:  $(n-2) \times 180$  degrees, where  $n$  is the number of sides.
  5. For a pentagon ( $n=5$ ):  $(5-2) \times 180 = 3 \times 180 = 540$  degrees
- These are the total degrees for each shape! If you'd like to learn more about any of these or how to calculate angles for other shapes, just let me know!

#### Poppy (5th Iteration)

Hi! It's great to start by thinking about the number of degrees each shape has.

Can you tell me what you already know about degrees in different geometric shapes?

For instance, do you know how many degrees are in a triangle?

# Reflections And Presentation

### Process Presentation at Gyldendal

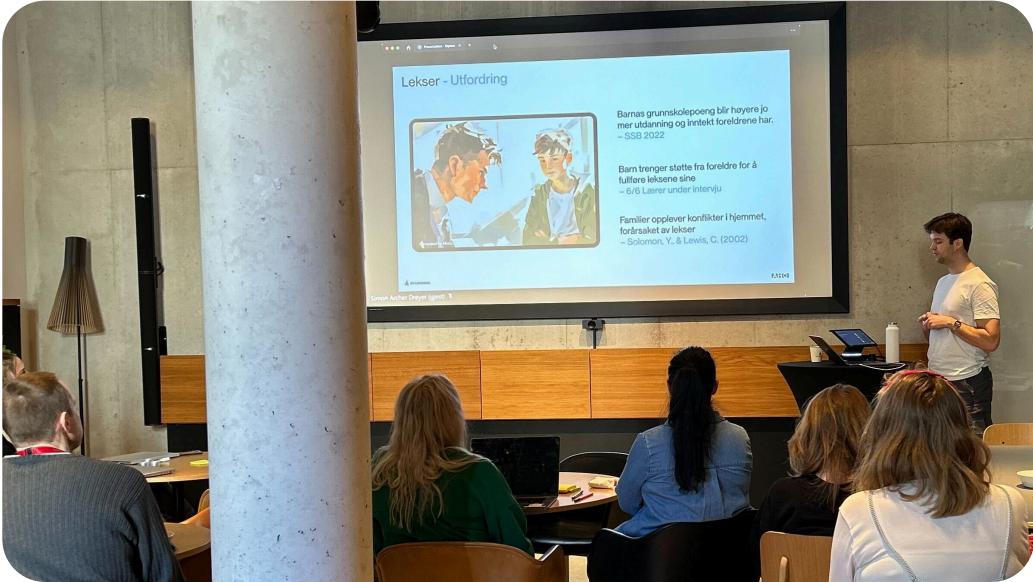
A presentation at Gyldendal, with a mixed audience of editors, teachers, designers and technologists of 30, highlighted the project's progress and gathered valuable insights from educational professionals. Feedback focused on enhancing language understanding, exploring challenges related to understanding illustrations and visuals, and ensuring personalized and accessible learning experiences.

### Continued Development

The testing process, although limited in scale, provided critical insights for iterative development, emphasizing the necessity of a user-centric approach and the potential for broader application within educational settings.

### Challenges and Future Directions

The need for more extensive testing and the complexities of obtaining parental consent were acknowledged, underscoring the operational challenges in deploying AI tools in sensitive settings like education and at home.



### Audience's Thoughts After Presentation

<p>Litt som en klassebåse</p> <p>Relationship</p>	<p>Teste med forskjellige dialekter. Siri forstår ikke min dialekt så godt.</p> <p>Accessibility</p>	<p>Hva om man vil forstå noe som en illustrasjon i en bok → Der hvor en lærer ville vise og peke?</p> <p>Technology</p>	<p>"Min datter på 14 forventer forklaring på samme måte som på skolen -Sokratiske metoden kan kanskje hjelpe på det"</p> <p>User Needs</p>
<p>Er dette noe læreren setter opp eller elevene/foreldre?</p> <p>User Needs</p>	<p>Gi tips til elevene som er litt fremoverlent "Du burde jobbe litt mere med dette..." Smarteving-Gigagraf</p> <p>Performance</p>	<p>Fint at assistenten stiller spørsmål og ikke gir svaret.</p> <p>Technology</p>	<p>Hvordan gjorde de (eleven og assistenten) matteoppgaven sammen?</p> <p>Relationship</p>
<p>Hva er mandatet? • Hypotese/lage verktøy?</p> <p>Trust</p>	<p>Tilpasset GPT, på hvilken måte?</p> <p>Technology</p>	<p>Språk og begreper, noe tema kan gåes gjennom på forskjellige nivåer (barn, ungdom, voksen etc)</p> <p>User Needs</p>	<p>Sikkerhet og personvern rundt lydopptak</p> <p>Trust</p>
<p>Vi er voksne som vet hvor vi skal → Hvordan vet elevene hvor velen de skal gå er? Er det riktig vei de går?</p> <p>Curiosity</p>	<p>Likte veldig godt formen, menneskelig og rund i motsetning til teknologi. Varm i formen, og kommuniserer "støtte"</p> <p>Relationship</p>	<p>Hva med de som har utfordringer med hørsel eller som ikke kan engasjere seg i dialog?</p> <p>Accessibility</p>	<p>Hvordan ville denne fungert i en kreativ prosess, noe som ikke har en fasit?</p> <p>Curiosity</p>
<p>Hvem har ansvaret for å holde seg på sporet?</p> <p>Curiosity</p>	<p>Begeistring! - Satt i går med frustrert datter som ikke fant det hun trengte inne på skolens ressurser.</p> <p>Accessibility</p>	<p>Hvordan forklarer den hvor noe er hvordan kommer man seg tilbake på sporet</p> <p>Relationship</p>	<p>Datter som er totalt skoleflink, spoler i videoer, søker på nett, skummer gjennom tekst. Hvordan skal den dialogen være? "Jeg gidder ikke!"</p> <p>Performance</p>

# Resilience Through Support

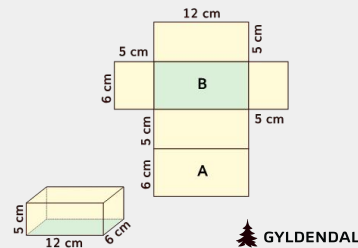
This chapter explores a shift in Poppy's design philosophy, emphasizing its role as a tool that complements, rather than replaces, human educators and parents. Traditionally, designers simplify user tasks, but this reliance on technology can diminish cognitive skills (Sparrow et al., 2011). Parents worried that children interacting with AI might lose critical thinking and creativity, becoming dependent on technology. Therefore, Poppy embraces "necessary friction" to enhance learning and foster critical thinking, encouraging users to engage their knowledge and reasoning alongside external information.

During user testing, children initially struggled to articulate their needs and questions. However, they adapted over time, learning to express their thoughts more clearly and effectively. This observation suggested a new direction for educational support, where the challenges of a voice interface could strengthen user engagement and cognitive abilities.

“Aah, I don't even know how to describe this to get help from Poppy.”

– 14 year old during user-testing  
(After som back and forth managed to solve the task)

The figure shows a box that has been unfolded. What is the combined area of A and B?



Instead of designing for effortless simplicity, Poppy uses the "friction" of a voice interface as a pedagogical tool rather than a hurdle. Initially, I considered incorporating a camera into Poppy but realized that the use of verbal communication actually strengthened users' ability to articulate their thoughts and problem-solving processes. While large companies developing AI models seek extensive data to enhance their systems, I believe this creates a conflict between optimizing the models and fostering human learning opportunities. Like a teacher guiding students without giving answers, Poppy encourages users to ask thoughtful questions, break down problems into manageable steps, and articulate their reasoning aloud, enhancing problem-solving skills and effective communication.

This design philosophy goes against the trend of simplifying user experiences. By embracing friction, Poppy empowers users to become active learners, develop critical thinking, and gain confidence to tackle challenges independently. This approach ensures Poppy complements the guidance and support of human educators and parents, contributing to a balanced and enriching educational landscape.


“I first said the question to myself before asking Poppy, to make sure I knew what I was going to ask.”


– 16 year old during user-testing


# Poppy: Design and Value


Imagine a helpful friend that is by your side and always ready to assist with homework – that's Poppy. Ask questions out loud and get immediate guidance, like having a personal tutor available anytime, without the cost. Poppy helps understand concepts, solve problems, and boosts confidence. By using voice instead of a screen, Poppy keeps students focused and engaged, making learning a more interactive and enjoyable experience.


## Key Features


 **Personalized Learning**  
Poppy tailors responses based on individual learning styles and adapts to progress, making learning more effective

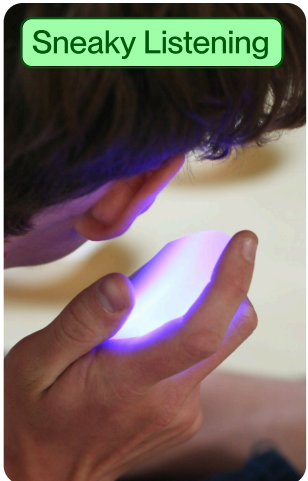
 **Voice Interface**  
Promotes active listening, clear articulation, and reduces screen fatigue, fostering communication skills and focus.

 **Dedicated Device**  
A distraction-free environment, unlike multi-purpose smartphones, encourages a dedicated space for learning.

 **Necessary Friction**  
Poppy encourages critical thinking by guiding students to solutions, not just direct answers, leading to deeper understanding

 **Tangible Design**  
A comforting, ergonomic form factor encourages interaction and provides a tactile learning experience.

 **Transparent Interactions**  
Click and hold to ask, release when finished. Poppy only listens when you choose, ensuring your privacy is protected.



“Poppy is an AI that makes you think for yourself.”  
– 14 Year old during user-testing



Learning that keeps up with your curiosity. Wherever it takes you.



# Management Interface

To continue the exploration of possibilities and extending the usability of Poppy I created this management interface to address concerns raised by various people I interviewed. Parents can customize Poppy's behavior and learning experience through a user-friendly interface accessible through the web, as well as through conversation with Poppy.

### Model Provider & Behavior

Choose from AI models aligned with Norwegian educational standards and customize responses with content filters.

### Multilingual Support

Set standard language or select multiple languages for bilingual students or language learning.

### Connectivity & Personalization

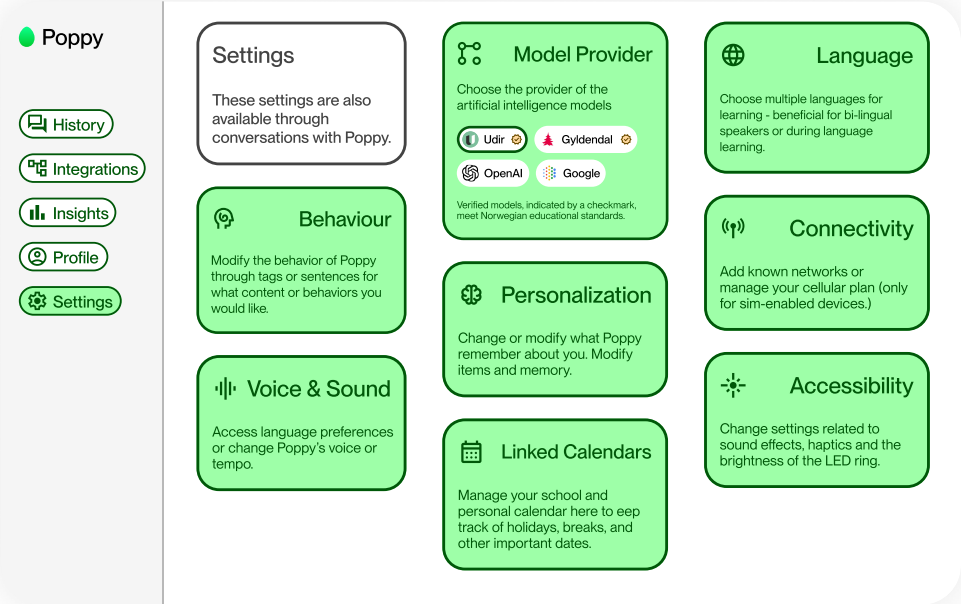
Manage network connections or cellular plans, control personal information Poppy remembers.

### Voice & Accessibility

Adjust voice settings, audio feedback, and voice characteristics for individual needs.

### Linked Calendars

Integrate school and personal calendars for reminders and scheduling.

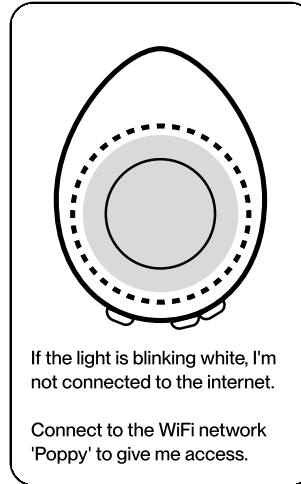
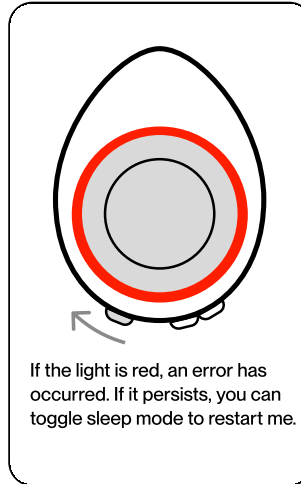
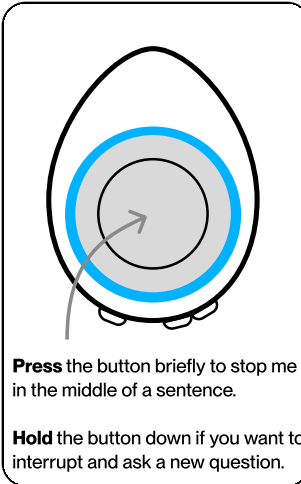
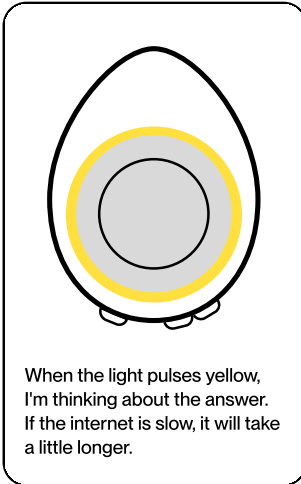
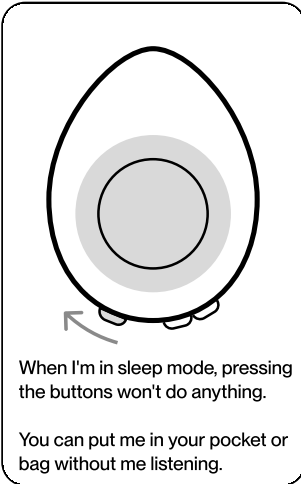
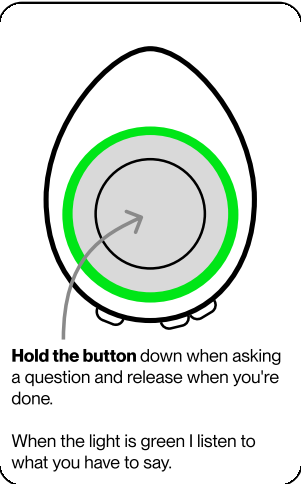


# Conversational Flow

Poppy's design ensures a natural and intuitive conversational flow, connecting software, hardware, and user experience.

- 1. Asking:** Press and hold the button while speaking your question. Poppy's green light confirms its listening. Release the button when done, allowing for pauses and thoughtful phrasing.
- 2. Processing:** Poppy's light pulses yellow as it processes your request and generates a personalized response, visually indicating the thinking process and managing expectations regarding internet speed.
- 3. Responding:** Poppy delivers the answer and the light turning blue to signal it speaking. Adjust the volume as needed for a clear and engaging multi-sensory experience.
- 4. Interacting:** Seamlessly interrupt or ask new questions. A short press stops Poppy mid-sentence. Holding the button allows you to interrupt and ask a new question, mirroring natural conversation flow.

## Videos of scenarios in Appendix: Scenarios



## Poppy Is...

### ...Listening



### ...Thinking



### ...Talking



# Tangible Interactions and Product Design

## Conventional Voice Assistants

While traditional voice assistants like Siri cater to broad, general purposes and often come embedded in multi-function devices like smartphones, Poppy is designed specifically for the educational sector. Common devices fail to offer the specialized, distraction-free environment needed for focused study. Poppy's dedicated nature ensures it serves its primary function without the interruptions typical of smartphones.

## Beyond Existing Devices

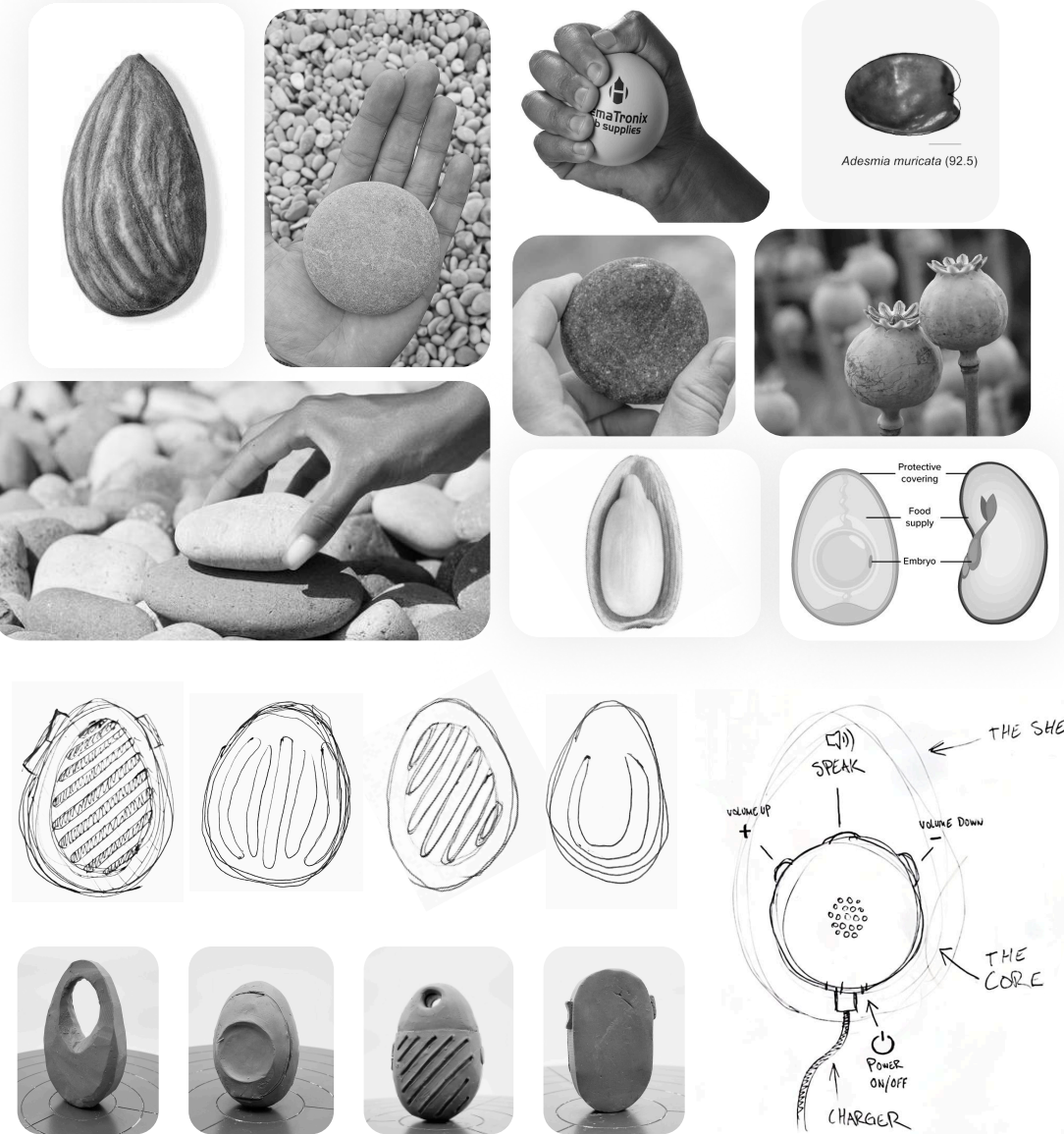
Unlike smart speakers confined to one location and raising privacy concerns with their always-listening mode, Poppy is designed for mobility and user control. Its portability allows students to learn wherever they are most comfortable, directly addressing a need expressed by both parents and students. The tactile, seed-like form, inspired by stress-relieving objects, encourages interaction while promoting a calm and focused learning atmosphere. Poppy's push-to-talk functionality ensures privacy, giving users agency over when the device is listening, further reinforcing a sense of control and intentionality during the learning process.

## Inspiration and Symbolism

The seed-like shape of Poppy not only makes it ergonomic but also symbolizes growth and potential, resonating with its educational purpose. The smooth, natural form factor is designed to be both aesthetically pleasing and functional, encouraging interaction and engagement.

## Videos of product process in Appendix: Product Process

**Growth Potential Protection Care Portable**





## Iterative Prototyping

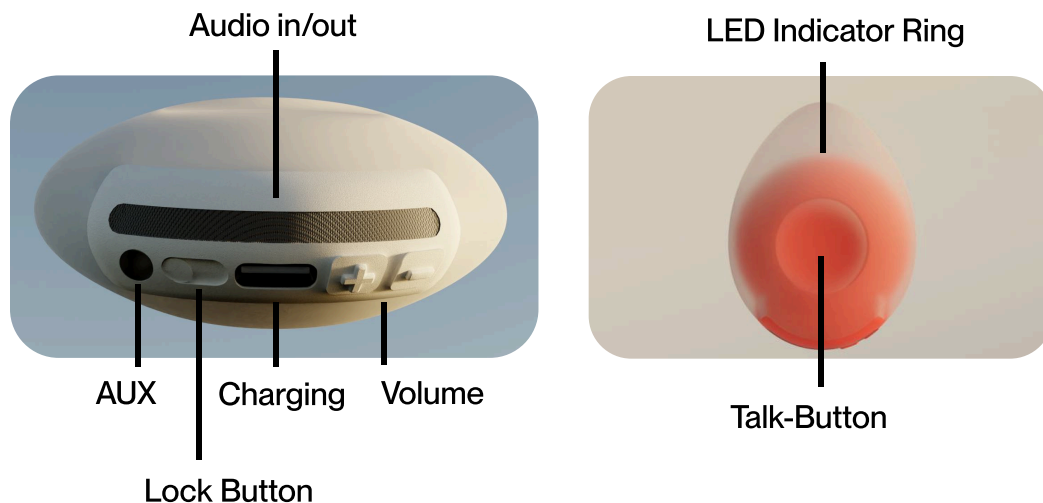
Prototyping involved multiple stages, including clay modeling and 3D printing, allowing for extensive user feedback on the tactile aspects of the device. This feedback led to the incorporation of a silicone shell, enhancing durability and comfort, and providing a non-distracting, pleasant tactile experience. Customization options in the core's color and shell's shape also enable users to personalize their device, making it a more integral part of their learning process.

## Audio

A consideration in Poppy's design, resulting in the overall larger size than originally intended, due to a bigger speaker chosen to avoid the common mistake of tinny sound in smaller portable devices. The full-range speaker with sufficient bass ensures clarity and richness in voice output, enhancing the overall user experience. The spherical design of the core improves sound quality by preventing issues like standing waves.

## Interactive Elements

Practical considerations in the design include easily accessible controls for talk, volume, and lock functions, preventing accidental activations. An LED indicator within the core visually communicates the device's status, further enhancing user interaction by providing clear and immediate feedback.



In summary, Poppy's physical design and features stem from a deep understanding of the needs within educational contexts, prioritizing ergonomics, privacy, portability, and user engagement to create a supportive and effective learning tool.

# The Teacher Role

Poppy could empower teachers to reach new heights of instruction. Imagine a history lesson where students, aided by Poppy, individually research key events, going deeper into topics of their interest. This frees the teacher to facilitate a debate, guiding students to analyze conflicting perspectives and construct well-supported arguments.

Poppy's support allows all students to have foundational knowledge, letting them participate confidently in the debate, regardless of their prior understanding of the topic. This personalized approach can bridge the gap between struggling and advanced students, creating a more inclusive and engaging learning environment.

The focus is not about replacing teachers, but about amplifying their ability to do their part in the classroom and enable collaborative learning, leading to deeper understanding and a more meaningful connection with the subject matter.



Ai-Generated

# A Shared Future

Poppy's emphasis on individual learning styles reflects a broader societal shift. In our era, fostering individuality and embracing diversity are not just trends but necessary. Challenges like climate change and geopolitical tensions demand collaborative solutions that draw on diverse perspectives and experiences. As workforces become more globalized and interconnected, effective cross-cultural communication is essential.

In my opinion it is crucial for educational institutions to adapt by moving away from standardized, one-size-fits-all approaches. Curriculums should prioritize critical thinking, problem-solving, and collaborative skills alongside traditional academic knowledge. Thoughtfully implemented technology can facilitate these shifts, personalizing learning experiences and connecting students across geographical boundaries.

As students grow into more pronounced individuals, the range of ideas, perspectives, and problem-solving strategies they bring to the table expands. This diversity can help innovation and creativity but also presents communication challenges.

Effective communication becomes crucial — not just as a basic skill but as the most essential tool for effective collaboration. Clear communication is necessary to articulate distinct ideas and understand others' perspectives, helping to bridge gaps and harness the full potential of diverse teams.

**Clear communication prevents conflicts arising from misunderstood perspectives.**

# Creativity, Communication and Collaboration

In this era of uncertainty, it's important for education to focus on fundamental human values. Effective communication has always been fundamental to human progress, facilitating collaboration, innovation, and knowledge transfer across generations. We are now experiencing a paradigm shift where communication extends beyond humans to include artificial intelligence (AI) and large language models (LLMs).

LLMs, capable of processing and generating human language, create new opportunities for collaboration and knowledge creation. We can imagine a world where problems are solved by human-AI teams, where language barriers disappear, and creative challenges are solved through the combined power of human skill and machine learning.

“It's the first time in human history that nobody has any idea how the world will look like in 20 years”

– Yuval Noah Harari

Education today is preparing future generations for this new era. Curriculums need to adapt to include technical skills, effective collaboration with human and machine, sourcing reliable information, and navigating the ethical complexities of a increasingly technology-driven world.

The future of communication involves creating a collaborative ecosystem where human and artificial intelligence work together to solve challenges, enable innovation, and build a more inclusive and sustainable future. This requires ensuring that technological advancements are guided by human values and that AI benefits are accessible to all.

As we enter this new world, where machines increasingly speak our language, the key question is not just how to program them, but how to ensure they help us connect, create, and collaborate. The future of communication is in our hands, shaped by our actions today. Poppy represents a seed, taking root in teenagers and embodying the principles of creativity, communication, and collaboration needed to thrive. By nurturing this seed, we can grow a future where technology and humanity flourish together.

“It is our job to create computing technology such that nobody has to program. And that the programming language is human.

Everybody in the world is now a programmer. This is the miracle of artificial intelligence.”

– Jensen Huang - CEO of Nvidia

# Culturally Aligned Models

Although grade level is commonly used to gauge a student's academic progress, it doesn't account for individual learning differences or the specific educational contexts that vary significantly across countries. This is particularly evident when using AI models trained primarily on data from one region, such as the United States, which may not align well with educational frameworks and student abilities in other regions, like Norway. For example, during testing, relying solely on grade-level assumptions based on American data led to misinterpretations of Norwegian students' knowledge levels. This discrepancy can undermine the effectiveness of personalized educational support, as it fails to recognize both variations between educational systems and individual differences among students.

LLMs are just as powerful as the underlying training data, potentially passing on the harmful stereotypes and cultural assumptions that are present. If Poppy relied solely on models trained primarily on American data, like ChatGPT, it could make inaccurate assumptions about Norwegian students or unintentionally reinforce biases, particularly in areas like gender and cultural representation. To help overcome these assumed intentions, Poppy has two techniques. First, it actively engages students through interactive questions and prompts to gauge their individual understanding, not making judgements about their grade or existing understanding, adapting the response to their specific needs and knowledge. Second, the project emphasized the development of localized AI models trained specifically on Norwegian data, ensuring cultural relevance and alignment with Norwegian values.

Experts like Ivar Berg (Former head of Google Education Norway) and discussions with Gyldendal confirm the importance of this localized approach for building trust and ensuring the quality of Poppy's responses, both culturally and academically. While such models are not yet readily available, Gyldendal's interest in exploring this possibility highlights a promising path towards more fair and effective AI-powered learning experiences

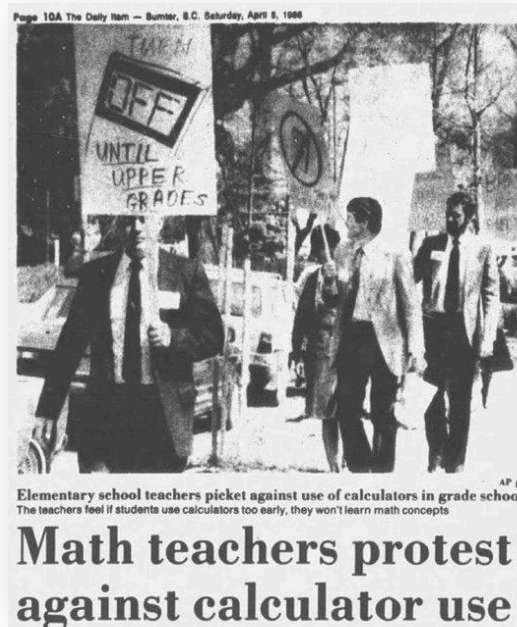
# The Broader Educational Setting

## School

Poppy, though initially designed for teenage students, demonstrated potential to positively impact both classroom and home learning environments. Teachers, recognizing the unique advantages of voice interaction, envisioned Poppy as a versatile tool. Imagine a bustling classroom where a student, struggling with a complex math problem, discreetly whispers their question to Poppy through connected headphones. Poppy, in turn, provides personalized guidance without disrupting the flow of the lesson, allowing the student to continue working independently while the teacher focuses on other students.

One teacher suggested using Poppy themselves to track daily attendance or set reminders for upcoming deadlines, freeing up valuable time for personalized instruction and interaction with students.

While classroom implementation requires careful consideration, the potential for Poppy to enhance both independent and collaborative learning experiences, while simultaneously supporting teachers in their multifaceted roles, is significant.



Lawrence, J. (1966, April 5). Math Teachers Protest Against Calculator Use. The Daily Item, p. 10A. Retrieved from <https://dailyitem.newspapers.com/image/512679864/?match=1&terms=math%20teachers%20protest>

It's important to emphasize that Poppy is not intended to replace the essential role of human educators. Instead, Poppy is designed as a collaborative tool, enhancing and expanding the teacher's capacity to support individual student needs. Poppy can act as an "always-available" assistant, providing personalized guidance and feedback on demand, freeing up the teacher to focus on tasks that require their unique human expertise.

Think of a teacher working with a small group of students while other students utilize Poppy for individualized support on a specific concept. This allows the teacher to provide in-depth guidance to those who need it most, while simultaneously ensuring that other students are actively engaged and progressing in their learning. Poppy's role is to augment, not diminish, the vital human connection and pedagogical expertise that teachers bring to the classroom.

## Home

Parents, initially hesitant about introducing Poppy at home, saw its potential for streamlining communication and easing the burden of managing their children's busy schedules. Imagine a parent, juggling work deadlines, asking Poppy about their child's school calendar, staying informed about homework assignments and school announcements.

Poppy, integrated with platforms like GyldeDal Skolestudio and ItsLearning, could act as a hub for school-related information, reducing the need for parents to navigate multiple platforms and enhancing their involvement in their child's education. The integration of Poppy into both school and home settings presents a promising avenue for strengthening communication and collaboration, creating a more supportive and effective learning ecosystem for all involved.

# Accessibility and Distribution

## Reaching Those in Need

Poppy's core mission is to bridge the educational gap and reach students who lack adequate homework support. Partnering with organizations such as Røde Kors and exploring government-funded initiatives, could place Poppy in public libraries and schools within underserved communities. This approach prioritizes accessibility while avoiding stigmatization by positioning Poppy as a desirable learning companion for all students.

## Open-Source Possibilities

Inspired by the growing open-source AI hardware movement, exploring an open-source development model for Poppy presents exciting possibilities. Sharing design files and code would empower tech-savvy individuals and communities to build and modify their own Poppy devices, fostering innovation and global accessibility. Although this approach aligns with the project's core values of democratizing education and empowering learners, it would require technical understanding and special tools to create your own Poppy.

## Balancing Idealism and Reality

Achieving widespread accessibility presents significant challenges. Pilot programs in partnership with educational institutions or NGOs would provide valuable insights into implementation strategies and long-term sustainability. Building a strong community around Poppy, fostering collaboration, and exploring creative distribution channels are crucial for maximizing its impact and ensuring its long-term success. Also exploring how the role of homework would and should change with such a new tool would also be required for it to have the beneficial impact it could.

## Expanding Reach and Impact

Collaborating with Gyldendal on this diploma project has been insightful. Their final feedback highlighted not only Poppy's potential for fostering educational equity but also the exciting possibilities for its integration within existing educational ecosystems. Gyldendal recognized Poppy's ability to level the playing field for students with varying needs and learning styles, addressing limitations in current homework support systems. They see Poppy addressing the need for multilingual support. Their preference for voice interaction over traditional text-based chatbots further validates Poppy's design choices. Gyldendal's vision for integrating Poppy with their established platforms, such as Gyldendal Skolestudio, leveraging their content and expertise, underscores its potential to become a comprehensive, culturally relevant learning tool.

This vision for Poppy's future extends beyond traditional homework assistance. Gyldendal imagines Poppy becoming an integral part of the Norwegian learning environment, seamlessly integrating with existing digital and physical resources. This aligns with the project's broader goal of fostering a love of learning and empowering students to take ownership of their education.





# Reflections and Conclusions

## User-Centered Design

Poppy's development was a continuous back and forth between the initial hypothesis and the realities of user interactions, using the principles of the scientific method. I began with the hypothesis and goal of creating a seamless homework assistant, but through testing, observation, and refinement, I discovered that true learning requires active engagement and not just ease of use. This realization led me to embrace the concept of "necessary friction." This journey began with a simple observation: educational inequality in Norway is a continuous challenge, often worsened by limitations within the existing homework support system.

Research revealed a key target user group: early teenagers (12-16), navigating the complexities of abstract thinking and growing independence, yet still in need of guidance. Homework, despite its challenges, was recognized as an entrenched part of education, leading to a focus on improving the existing homework process, rather than simply supplementing it. User testing unveiled unexpected insights. What was initially perceived as friction, the challenge of articulating needs and formulating questions for Poppy, proved to enhance learning by encouraging active engagement and problem-solving. This led to the "friction as pedagogy" design principle, where Poppy guides students towards solutions rather than simply providing answers. Similarly, early prototypes with lower-quality audio underscored the importance of a rich sonic experience and a comforting form factor.

The initial vision expanded throughout the development process. Poppy evolved from a tool for individual students to encompass teachers and parents, leveraging its potential to streamline communication and strengthen the overall learning ecosystem. The limitations of a US-centric LLM highlighted the need for localized training data and bias mitigation, essential for creating a culturally relevant and equitable tool for Norwegian students.

This iterative process, characterized by observation, experimentation, and adaptation, mirrors the principles of the scientific method applied to the field of design. This approach has shaped Poppy's form but also reinforced the core values of empathy, responsiveness, and an understanding of the user experience as essential elements of successful design.

## Limitations & Further Exploration

This project centers on solving user needs and interacting with Poppy but also highlights unexamined benefits like improved memory retention (Mueller & Oppenheimer, 2014), comprehension, and fine motor skills from handwriting and analog homework. Timely assistance helps maintain flow and reduces distractions. Further research could explore combining analog and digital methods, multilingual tutoring for accessibility, and fostering peer interaction through social and collaborative learning. Additionally, insights from Poppy could be analyzed and provide teachers with enhanced understanding of their students and tailored learning strategies accordingly.

While Poppy's physical design establishes a basic visual identity, it could benefit from deeper exploration. Further development could investigate a broader range of materials, finishes, and color palettes to enhance tactile appeal and resonate with teenage users. A deeper dive into ergonomic considerations, addressing diverse hand sizes, grip strengths, and accessibility needs, would also strengthen Poppy's design and broaden its user base.

# External Validation

**Ivar Berg's Perspective:** Ivar Berg, former Head of Google for Education in Norway and Senior Education Program Manager at Microsoft, strongly supports Poppy's concept and design. With extensive experience in the Norwegian educational technology landscape, including contributions to Røde Kors Digital Leksehjelp, Berg provides valuable insight into Poppy's potential impact. He recognizes the significance of Poppy's tangible, screen-free design and voice interaction, emphasizing their role in promoting critical thinking and communication skills—key principles of the project's design philosophy. Berg also highlights the importance of addressing cultural relevance and potential biases within AI systems, advocating for the development of localized educational language models. His insights underscore the project's commitment to creating a responsible and culturally sensitive tool for Norwegian students.

**Gyldendal's Collaborative Insights:** Feedback from Gyldendal, based on our collaboration, highlights Poppy's potential to foster educational equity and seamlessly integrate into Norway's learning environment. They see Poppy as addressing limitations in current homework support, creating a more level playing field for students with diverse needs, including multilingual support. Their preference for voice interaction over traditional text-based chatbots validates Poppy's design choices. Gyldendal envisions integrating Poppy with their platforms, leveraging their content and expertise, underscoring its potential to become a comprehensive, culturally relevant learning tool. Their feedback also emphasizes the need to carefully consider classroom integration strategies, navigate ethical and legal complexities regarding AI and data privacy, and ensure transparency about Poppy's capabilities and limitations.

These insights form a strong foundation for shaping Poppy's future and maximizing its impact on Norwegian education. Any further development of this project will continue to prioritize user-centered design, cultural sensitivity, and ethical considerations while exploring strategic partnerships and innovative implementation strategies to ensure Poppy reaches its full potential as a valuable tool for promoting equitable and engaging learning.

**Ivar Berg**, former Head of Google for Education in Norway and Senior Education Program Manager at Microsoft, has extensive experience in the Norwegian educational technology landscape. He expressed strong support for Poppy and its potential to address challenges in homework support and educational equity.

Berg emphasized the importance of its tangible, screen-free design and voice interaction, which promote critical thinking and communication skills.

He highlighted the need of cultural relevance and addressing biases in AI systems, advocating for a Norwegian educational language model.

Berg suggested further exploration of the project's potential, particularly in the consumer market, and encouraged collaboration with relevant stakeholders.

**UX-Designer from Gyldendal share this:** “During school visits, we frequently observe students getting stuck while working on their tasks. When they try to seek help through digital products, they rarely get the assistance they need. Often, their options are to either guess and click through or sit with their hand raised, waiting for help from the teacher. It's challenging for the teacher to attend to everyone who needs help.

When it comes to homework, many students choose to wait until their parents come home to get help or simply guess and click through the tasks.

With Poppy, this will no longer be a problem. Poppy helps you when you get stuck.”

# Thank You

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Seeing the effort that teachers and tutors put in to their work was inspiring and makes me hopeful about the future of education.

# References

Bloom, B. S. (1984). The 2 Sigma Problem: The Search for Methods of Group Instruction as Effective as One-to-One Tutoring. *Educational Researcher*, 13(6), 4. <https://doi.org/10.2307/1175554>

Hill, N., & Tyson, D. (2009). Parental Involvement in Middle School: A Meta-Analytic Assessment of the Strategies That Promote Achievement. *Developmental Psychology*, 45, 740–763. <https://doi.org/10.1037/a0015362>

Hvordan påvirker foreldres utdanning og inntekt barnas karakterer? (n.d.). SSB. Retrieved 29 January 2024, from <https://www.ssb.no/utdanning/grunnskoler/statistikk/karakterer-ved-avsluttet-grunnskole/artikler/hvordan-pavirker-foreldres-utdanning-og-inntekt-barnas-karakterer>

Kasneci, E., Seßler, K., Küchemann, S., Bannert, M., Dementieva, D., Fischer, F., Gasser, U., Groh, G., Günemann, S., Hüllermeier, E., Krusche, S., Kutyniok, G., Michaeli, T., Nerdel, C., Pfeffer, J., Poquet, O., Sailer, M., Schmidt, A., Seidel, T., & Kasneci, G. (2023). ChatGPT for Good? On Opportunities and Challenges of Large Language Models for Education. 103, 102274. <https://doi.org/10.1016/j.lindif.2023.102274>

Kraft, M. A., & Falken, G. T. (2021). A Blueprint for Scaling Tutoring and Mentoring Across Public Schools. *AERA Open*, 7, 233285842110428. <https://doi.org/10.1177/23328584211042858>

Kuhlthau, C., Maniotes, L., & Caspari, A. (2015). Guided Inquiry: Learning in the 21st Century: Learning in the 21st Century. <https://doi.org/10.5040/9798400660603>

Lærerkompetanse. (n.d.). Retrieved 15 May 2024, from <https://www.udir.no/tall-og-forskning/publikasjoner/utdanningsspeilet/utdanningsspeilet-2022/grunnskolen/kompetansekrav-og-videreutdanning/>

Mueller, P. A., & Oppenheimer, D. M. (2014). The Pen Is Mightier Than the Keyboard: Advantages of Longhand Over Laptop Note Taking. *Psychological Science*, 25(6), 1159–1168. <https://doi.org/10.1177/0956797614524581>

Pérez-Juárez, M. Á., González-Ortega, D., & Aguiar-Pérez, J. M. (2023). Digital Distractions from the Point of View of Higher Education Students. *Sustainability*, 15(7), Article 7. <https://doi.org/10.3390/su15076044>

Pérez-Juárez, M. Á., González-Ortega, D., & Aguiar-Pérez, J. M. (2023). Digital Distractions from the Point of View of Higher Education Students. *Sustainability*, 15(7), Article 7. <https://doi.org/10.3390/su15076044>

Pressman, R., Sugarman, D., Nemon, M., Desjarlais, J., Owens, J., & Evans, A. (2015). Homework and Family Stress: With Consideration of Parents' Self Confidence, Educational Level, and Cultural Background. *American Journal of Family Therapy*, 43. <https://doi.org/10.1080/01926187.2015.1061407>

Rønning, M. (2011). Who benefits from homework assignments? *Economics of Education Review*, 30(1), 55–64. <https://doi.org/10.1016/j.econedurev.2010.07.001>

Saavedra, A., & Opfer, V. D. (2012). Learning 21st-Century Skills Requires 21st-Century Teaching. *The Phi Delta Kappan*, 94, 8–13. <https://doi.org/10.2307/41763587>

Solomon, Y., & Lewis, C. (2002). Helping with Homework? Homework as a Site of Tension for Parents and Teenagers. *British Educational Research Journal*, 28. <https://doi.org/10.1080/0141192022000005850a>

Sparrow, B., Liu, J., & Wegner, D. M. (2011). Google Effects on Memory: Cognitive Consequences of Having Information at Our Fingertips. *Science*, 333(6043), 776–778. <https://doi.org/10.1126/science.1207745>

The Late Show with Stephen Colbert (Director). (2024, March 5). How AI Will Shape Humanity's Future—Yuval Noah Harari. <https://www.youtube.com/watch?v=2w37ty9gGU8>

Udir, L. siden som. (2021, June 5). Hva sier forskningen om lekser? <https://www.udir.no/tall-og-forskning/finn-forskning/rapporter/hva-sier-forskningen-om-lekser/>

von Stumm, S., Hell, B., & Chamorro-Premuzic, T. (2011). The Hungry Mind: Intellectual Curiosity Is the Third Pillar of Academic Performance. *Perspectives on Psychological Science*, 6(6), 574–588. <https://doi.org/10.1177/1745691611421204>

Yadav, G., Tseng, Y.-J., & Ni, X. (2023). Contextualizing Problems to Student Interests at Scale in Intelligent Tutoring System Using Large Language Models (arXiv:2306.00190). arXiv. <https://doi.org/10.48550/arXiv.2306.00190>