# PROTOTYPE DEVELOPMENT TO MEASURE AND IMPROVE HIGH SCHOOL STUDENTS' SOCIAL INTERACTIONS

Bachelor of Science Thesis Creative Technology

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# Abstract

Interacting with peers can contribute to overall well-being and curb feelings of loneliness. However, there are many reasons why high school students avoid interacting with fellow students. This project thus aims to create a prototype that is able to lower this barrier of entry to these social interactions and make it easier to visualize these interactions.

With literature research, various factors that are involved in these social interactions are identified. To gain a deeper insight, field research was conducted with high schoolers, where it became clear that most if not all students conduct conversations as their primary way of interacting. Ideation began with the diverging and converging phase, where the main idea was selected, which involved a growing tree that has various flowers and fruits that indicate certain aspects of their conversation, such as how much they spoke or how loudly. Pilot tests were then conducted, and these remained inconclusive as to whether they had a significant positive effect on the conversations.

For future research, care should be taken so that the display doesn't become too overwhelming, and longer conversations with random pairings of high school students should be tested.

# Acknowledgements

# Table of Contents

# 1. Introduction

High school is the most formative year in one's life, where some of the largest biological and social changes occur. This leads to quite some adjustment both physically and mentally, and teenagers are thus most susceptible to feelings of loneliness [1].

Loneliness is a feeling experienced by a many people at different periods of their lives. According to De Jong Gierveld [2], loneliness is experienced when there is a disconnect between a person's perceived amount of quality social interactions and their desired amount of quality social interactions. Feeling lonely can have detrimental effects on one's overall well-being, and more specifically on one's mental wellbeing. While it is not clear whether feelings of loneliness directly lead to depression, it is evident that they sometimes go hand in hand, and that social interactions can act as a buffer to prevent loneliness [3].

As these consequences are bad for people's well-being, there are various sources of help available. However, sometimes, these resources are difficult to find and make use of. More recently, since the COVID pandemic happened, loneliness among elders has been at the forefront of different research. Loneliness amongst young adults and teenagers, however, has quite a lack of research.

While there's a plethora of reasons why someone might feel this way, there is little research done into why these high school students feel this way and how to help them. That is where this project comes into play. This project is part of a larger research project led by Carolien Rieffe [4] that has the goal of reducing loneliness among high school students.

The aim of this graduation project is to design a tool that works seamlessly with students' normal social interactions, making the barrier of entry for the interaction lower. The tool will be able to monitor and manipulate certain aspects of social interaction, allowing future researchers to conduct more in-depth research on teenagers' loneliness.

## 1.1 Research Questions

The research questions will be used to guide the project and keep the process streamlined. It will also prevent going outside of the scope of the research, and ensure that the relevant information is found.

For this project, there will be three main types of research questions for each phase of the project, each focusing on different aspects.

The research questions are:

- How to create a tool that seamlessly works into students' social interactions during their school breaks, that is able to monitor and collect data?
    - How do high school students normally interact with each other?
    - What are the important factors when looking at social interactions between high school students?
        - What are the factors that contribute to high school students' interactions with each other?
        - What are the factors that could deter high school students from interacting with each other?

- How do you measure social interactions?
  - What type of technologies have been previously used to increase interactions between high school students?
    - What types of technologies have previously been used to increase social interactions?
    - What types of technologies have previously been used to increase physical and social play?

## 1.2 Report Outline

This report is structured as follows: in Chapter 2, the background research will first be discussed, outlining the important points of detail and the main takeaways. After this the field research will be discussed and analyzed in Chapter 3, drawing the relevant conclusions. These conclusions will then be utilized in the ideation phase in Chapter 4. The ideation phase will be described with the different phases used, which will end with a final idea selected from which the prototype will be made. In Chapter 5, the realization of the prototype will be described, followed by the playtest procedure and results in Chapter 6. Chapter 7 will discuss the playtesting results as well as the limitations and future recommendations of this project. And finally, Chapter 8 will conclude this thesis, summarizing the results and future recommendations.

# 2. Background Research

All the research conducted in this project and previous assignments will be documents and discussed in this chapter.

## 2.1 Literature Research

For the background research, the main questions being researched will be: the contributing and deterring factors of social interactions, and measuring social interactions.

When researching contributing factors of social interactions, three types of beneficial social interactions were identified. The first factor was a person's interest in the activity that peers are partaking in [5]. If someone has a genuine interest in an activity, it is more likely that they feel motivated and stimulated enough to participate in that activity. With that, they would more likely interact with others to accomplish the group's goal, participating in teamwork and establishing social networks. Another factor is the person's sense of belonging. Jessup [6] describes the self-determination theory, a theory that illustrates one's basic need for competence, autonomy, and relatedness. When these needs are met, one feels noticed and seen as a human being, which helps someone feel more comfortable to open up and engage in conversations with others. Lastly, the availability of various ways to communicate with others can help someone engage in social interactions [7]. Having a sufficient amount of communication pathways allows one to pick and choose which venue is most comfortable for them. This can allow one to more easily partake in and create meaningful interactions with others.

Contrasting the contributing factors, there are also deterring factors when it comes to social interactions. For autistic people, the reason why they might not engage in as many social interactions is because of their social awkwardness [8]. Being unable to read social situations and social cues could be frustrating or confusing, which could ultimately lead to them not seeking out and establishing their social network. Similarly, people with visual impairments can experience difficulties when interacting with others [6], either by missing visual social cues such as facial expressions and body language, or by experiencing "otherness" when talking to others. While only people with disabilities have been mentioned, people without disabilities can still experience the same thing. Veiga [9] has described behavior styles seen in preschoolers, that gives insight into their different social needs. They describe three behavior types: reticent, solitary-active, and solitary-passive behavior. Children with reticent behavior would approach social situations cautiously, and not seek out social stimuli instinctively. Children with solitary-active behavior are content playing alone, usually exhibiting impulsive or aggressive behaviors, deterring others from interacting with them. Lastly, there are children with solitary-passive behavior, who tend to avoid social interactions due to internalized issues, possibly leading to shyness and anxiety. While this paper mainly focuses and describes preschool children, it is relevant to this project's research, as it is not unreasonable to assume that these behaviors persist till the teenage years.

Measuring social interactions can be quite difficult, however, some aspects of these interactions can be measured, which in turn can be analyzed and concluded whether the interaction was good or not [10]. Such aspects are active listening, asking good questions, repetitiveness, and interestingness. These all play a role in how people in a conversation might feel towards the other person. Most of these aspects are subjective, but there is enough overlap to draw reasonable conclusions from.

In a previous assignment, additional research was done into the different settings in which high school students have their social interactions, and the differences that students with disabilities and without might experience when interacting with their peers.

There were two main settings found wherein students interacted with their peers. The main setting is their school grounds [8 , 11], which contains different spaces, such as the classroom and activity hubs. In the classroom, students are able to talk face to face with other classmates and their teachers for different reasons, such as discussing class material, or preventing boredom. In this setting, students are in constant close proximity to each other, making social interaction nearly inevitable. There are also extracurricular activity spaces, such as the basketball court, or club rooms [8]. Within these spaces, students often rely on teamwork to reach a similar goal, sometimes in a fun or playful manner.  The second main space in which high schoolers communicate with one another is online [12], either on social media platforms or online video games. They use these avenues to make new friends and converse with people with the same interests. These spaces can be a hit or miss, however, as there is no restrictions whether the interaction will be positive or negative.

## 2.2 State of the Art

Current technologies related to social interactions will be analyzed in the following section, providing inspiration as well as design aspects that can contribute to the design process. Three categories of technology have been arbitrarily made, and are described further.

### 2.2.1 Technologies that Promote Social Gatherings

Some tools serve as a motivator or reason for people to physically come together and participate in an activity together. An easy way to achieve this is with games. Picoo [13] is an outdoor game console designed for children either at school or at their after-school care. Children each get handed a controller with LEDs, sounds, and vibrations to play various games that are led by their teachers or guardians. This game promotes and encourages children to participate and engage in physical activity, as well as interacting with others and working together towards a common goal. Another game that focuses on connecting strangers is sTail [14]. sTail is an interactive projection that allows people to easily participate in a simple game. It can be placed in large social areas, such as malls or schools, with a game that is easy to understand once you have stepped foot into it. When you enter the playing area, you gain a virtual tail, and every time you step on another person's tail, yours gets longer. It is an easy and effective way for a lot of people who are essentially strangers to each other to interact with one another, as the barrier of entry for participating is quite low. And lastly, there are board games that connect people who might already know each other to bond over competition or collaboration. Board games are a social and usually analog way to play games. As the name suggests, it consists of a board on which the game is played. It comes in different varieties, whether it is competitive, collaborative, or simply entertaining. Some popular examples are Monopoly, Snakes and Ladders, and Clue.

### 2.2.2 Technologies that Lessen Feelings of Loneliness When Alone

When you're alone, there are some tools that can either simulate human interaction or connect you with people who aren't physically near you. ElliQ [15] uses AI to create a virtual companion that helps the elderly feel less alone. It allows users to talk and converse with the tool, possibly an activity that they otherwise are not able to partake in due to circumstances. With the help of AI, the tool is able to adapt to its user and develop a personality, most likely ensuring that the

conversation stays lively and the user is able to upkeep the desired quality of social interaction, if they are not able to achieve that with human beings. It is, however, limited by its AI and might not be able to fully simulate human interactions. Social media, on the other hand, allows one to connect and converse with others from all over the world. The barrier of entry is low, as you mainly need a smartphone and good internet access. With social media, seeing other people's lives and thoughts can make one feel less lonely, and make it easier to connect to other people. It does come with a lot of downsides, however, as there is a risk of data security and nowadays being exposed to content that might be upsetting. This ease of access to other humans also makes it easier to anonymously reach others, whether positively or maliciously. Examples of popular social media platforms are Instagram, X, formerly known as Twitter, and Facebook.

## 2.2.3 Technologies that Connect Strangers with Mutual Interests

There are also technologies that aim to connect strangers with mutual interests so their interaction has something to build off of. Dating apps, just like social media, can be a way to reach out to other people quicker without meeting them face to face yet, with the potential of deepening your relationship with that person. Here, you can curate your interests and connect with other people who have similar interests to you. A good relationship could start from this, but just as with everything else online, it is possible to be deceived, or catfished, as it is easy to mask who you are. Well-known dating apps are Tinder, Bumble, and Hinge. Online multiplayer games are an easy way to talk to other people with similar interests, as you are playing the same game. The game can be competitive, collaborative, or relaxing, where the focus is to converse with others when you want to. Where board games are geared towards people who already know each other, online games usually connect strangers. This is usually done via voice and/or text chat. However, these spaces are deemed to be "toxic", especially to women, as these are male-dominated fields. In games such as League of Legends, Counterstrike, and Valorant, you are able to communicate with your teammates to defeat the enemy together. There are other more "comfy" types of games, such as Webfishing, where the goal of the game is simply to fish. On a server, you could encounter other players, and via text or voice chat, you are able to converse.

## 2.2.4 Discussion and Takeaways

A lot of tools and media have been made to connect people, whether they already know each other or they are complete strangers. Nonetheless, each technology has its upsides and downsides. The context for some requires participants to make the interaction an "event" in their lives, like Picoo and sTail and board games where participants choose to participate in a game with others, which usually doesn't happen in conjunction with their everyday tasks. However, because it is separate from their every day, participants might be able to enjoy the interaction more. It also provides a goal that they want to achieve, whether alone or together.

ElliQ provides companionship to the elderly who might not have many social interactions. It is able to develop and evolve into a companion that fits the needs of its users over time, and the barrier of entry is quite low. However, there are ethical and environmental concerns with using AI and it does not quite capture a real human interaction. Social media also has a low barrier of entry, and you're able to curate what you see to connect with like-minded people. A downside of social media, however, is the large amount of people you are able to interact with, which can be overwhelming.

Dating apps, like social media, allow you to curate what you see, and based on those interests you are able to directly interact with like-minded people, which could lead to a deeper relationship. A large downside, however, is that people are able to lie, which could lead to false matchups, resulting in unwanted interactions. Online multiplayer games are great in their options to interact with others, providing choices that allow one to interact in whichever way they want to.

Taking all this into consideration, the prototype should include a goal that motivates users to interact and could allow them to interact in whatever way they want to without getting overwhelmed and minimizing unwanted interactions.

# 3. Field Research

In this section, the collected and analyzed data will be discussed that will allow us to understand which activities high school students partake in or not, and different aspects surrounding it.

## 3.1 Initial data collection

To gain an initial and global understanding of the activities that high school students do during their breaks, informal conversations were had with a few university students, former high school students, about what they did during their high school year. It was deemed sufficient to ask these people about their experiences, as it hasn't been more than 5 years since they were in high school. Naturally, it is likely that the activities are not in line with what high school students do nowadays, but this will be discussed in further detail in the following sections.

After conducting these informal chats, various different activities were mentioned and analyzed, and six activity categories emerged. These categories are:

1. Engaging in conversation
   This seems to be the activity done most among high school students, most likely because it is relatively easy to engage in and can be done in combination with other activities. This activity usually involves friends, but can also be used to make new friends. This activity is scalable with a minimum of two people and can involve as many as possible, though the comfort and understanding levels will deteriorate after a certain point, depending on the topic and interrelationships.

2. Playing games
   This activity can usually involve a limited amount of players, with possible spectators if they still want to be involved. With this activity, students gather together to engage in either fierce competition or teamwork towards a common goal. Within this category is defined both card games as well as mobile games.

3. Participating in sports
   Students gather in an area, usually an open one or an area designated for the sport, and participate in competition and teamwork together. It allows students to engage in physical activity in a fun manner. This activity is scalable but can be limited by the resources and physical abilities of the students.

4. Watching videos/content
   With this activity, students gather to watch videos or watch other types of content together. This allows them to relate to each other and engage in lively conversation about the content. The scalability is dependent on the size of the screen and the students' visibility of the screen.

5. Study session
   This activity is done during breaks, usually when homework needs to be done or there is an upcoming exam. It allows students to work together towards a common goal, and share information.

6. Being creative
   During breaks, students can participate in creative activities to destress or work on projects that they otherwise do in their free time at home. These activities can be done alone or with other people, in which case students could bond over the activity.

The above-mentioned activities allow for a wide variety of activities that this tool can be made for and provide a nice overview of what high school students might do during their breaks. To gain a deeper insight into their activities, further data collection will be done, in the form of surveys and in-depth semi-structured interviews, as described in the following sections.

## 3.2 Survey data

A questionnaire was sent out to some high school students, which mainly focused on asking 16 to 18-year-old high school students about their activities during breaks at their school. This pertained to questions about what they do, what they see other students do, whether or not they would want to join in, and why they would not be able to participate in activities.

The survey got a total of 10 responses, with 8 valid responses due to either not being old enough to participate or not currently being enrolled in high school. The results can be seen in the table below.

| Activities they do | % in answ. | Activities others do | % in answ. | Don't want to join | % in answ. | Can't join | % in answ. |
|---|---|---|---|---|---|---|---|
| Talk w/ friends | 100% | Talk w/ friends | 62.50% | No | 87.50% | No | 62.50% |
| Eat | 37.50% | Go to shops | 37.50% | Depends | 12.50% | Yes | 37.50% |
| Schoolwork | 37.50% | Eat | 25% | | | | |
| Go to shops | 12.50% | Play games | 25% | | | | |
| On phone | 12.50% | Vape/Smoke | 25% | | | | |
| | | Make videos | 12.50% | | | | |
| | | Schoolwork | 12.50% | | | | |

*Table 1. High school student's answers to the questionnaire.[1]*

Participants gave a total of 5 different activities they did during their break, with talking with their friends mentioned the most, appearing in all of their answers. This activity includes walking around with friends, sitting down with friends, and simply just "chilling". Two other activities were mentioned by less than half of the participants, and these were 'Eating' and 'Doing schoolwork'. Under 'Doing schoolwork' is included doing homework, studying for a test, or working on projects. While eating is assumed to be a thing every student does during their break, seeing as it wasn't an activity that popped into their minds during this questionnaire, it is reasonable to assume that they don't regard eating as a social activity. This of course does not mean that a tool can't be made for this activity.

When asked what participants see other people doing, they gave more or less the same answers, talking with friends, eating, going to shops, etc. New activities appeared in this question, which are 'Making videos', which only appeared once, and 'Vaping and/or smoking', which appeared twice.

Participants gave an almost resounding 'No' when asked if there were activities they wanted to participate in that others were doing. Only one participant said that it depended, as going to

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[1] The percentages given for each answer is the amount of times it appeared in their answers. So talking with friends in the first column appeared 100% of the time in their responses, which means all students had talking with friends in their response.

shops would cost a lot of energy for them. The true meaning of why most participants didn't want to join in other people's activities is yet unclear from this questionnaire, so when doing interviews more insight can be found.

For the question of whether there were activities they didn't want to participate in, a few activities were mentioned, most prominently vaping and or smoking. Engaging in "delinquent activities" was mentioned, which in their words included hanging around gangs outside of school to be cool, and skipping classes after the break.

For the final question, not many participants had activities they couldn't do. Three participants did have reasons for why they couldn't participate in activities. One participant sometimes can't join in talking with their friends, because they have no idea what the conversation is about. The other participant said that because they don't have a car, they can't join in with others who drive around and go to shops outside of school. And the last participant said they can't participate in "delinquent activities" as it would affect their grades and cause them to fall behind.

When asked if there were activities that could be improved upon, a variety of activities were mentioned. These were:

- Talking to friends
- Socializing
- Creating social gatherings to talk about mutual interests
- Eating
- Ability to play games (their example, with cards)


From these results, one activity stands out the most, which is talking with friends. Even while doing other activities, like eating or going to shops or even smoking, it is still possible to talk and "chill" with friends. This of course does not mean that students are satisfied with just talking to their friends, as this was the activity most mentioned when asked what can be improved upon.

# 4. Ideation Phase

After conducting field research, and obtaining information on what high school students like to do during their breaks, the ideation phase can begin. This chapter will present the ideation phase, which consists of the diverging phase, creating as many ideas as possible, and the converging phase, narrowing down and refining the ideas, until the final idea was selected.

## 4.1 Divergence

To start off the Divergence phase, a 3D creation matrix was made, with 'Technology vs Context vs Purpose'. The matrix can be seen in Figure 1 with the different ideas. The goal of this matrix is to come up with ideas for each of the available squares.



*Figure 1. 3D matrix of ideas*

The result was a myriad of different ideas that had different contexts and different technologies, in total 51 ideas, however, more ideas needed to be generated to fully explore all the possibilities. Thus, random ideas were combined to spark inspiration for new ideas, which generated an additional 27 ideas, which can be seen in Figure 2.
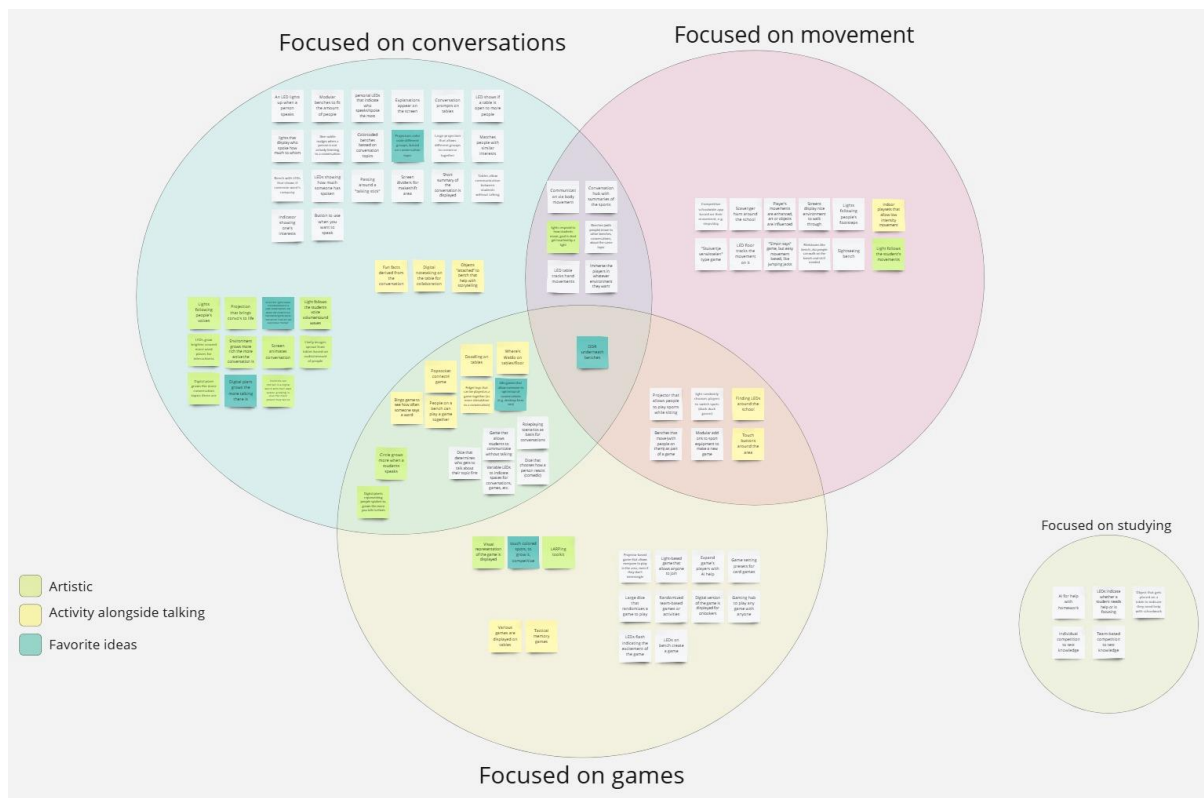
*Figure 2. Recombing ideas to generate new ones.*

As a final method to generate new ideas, and fully utilize the possibilities, the SCAMPER method was used. The SCAMPER method utilizes thinking of ideas in different ways to generate new ideas, assisting thinking outside of the box. The acronym stands for: substitute, combine, adjust, modify, put to other uses, eliminate, and reverse; the different approaches to thinking of an existing idea. Using these pathways, new ideas should spring forth. This only worked successfully with a few ideas, as some ideas didn't quite work with a perspective, or it generated an idea too similar to an already existing one. With this, an additional 15 ideas were generated, for a total of 93 ideas to work with.

## 4.2 Convergence

After exhaustive ideation of as many ideas as possible, it was necessary to narrow them down to eventually select the main idea from which the prototype will be made.

For the first part of the convergence, the ideas were placed in a Venn diagram, with each circle representing the different focal points of each idea. These focal points are 'Conversations', 'Movement', 'Gaming', and 'Studying'.

*Figure 3. Venn diagram of the ideas*

Ideas focused on 'Conversations' are mainly ideas that are centered around having conversations, whether it's an accompaniment to conversations or promoting conversations. Ideas focused on 'Movement' have the main purpose of promoting physical activity in a fun way. 'Gaming'-focused ideas have a gaming element to them, which could promote interactions. And finally, 'Studying' focused ideas are centered around helping students when studying or working on schoolwork in general. This Venn diagram can be seen in Figure 3. To further categorize the many ideas, some ideas were highlighted if they had a more artistic output or whether the idea was to be used alongside talking. A more subjective category is also highlighted, the 'favorite' ideas, as it was deemed important to also work on ideas that personally intrigue and motivate the researcher to develop them. Dividing and categorizing the ideas in this manner made the ideas easier to digest and differentiate at a glance, thus making it easier to identify the main ideas generated during this phase.

## 4.3 Evaluating the Main Ideas

After categorizing all the ideas, the main ideas can be identified, and now evaluated to determine which idea will be used for further development. The main ideas along with the evaluation criteria can be seen in Figure 4.

| Design Concept | Criteria | | | | | |
| --- | --- | --- | --- | --- | --- | --- |
| | Easily merges with everyday activities | Effective in social interactions | Accessible | Promotes interactions | Promotes movement | Achievable |
| DDR underneath benches | 🟢 | The activity might be too intensive to casually join in, and can also distract from conversations | 🟡 | 🔴 | 🟢 | 🟢 |
| Indicator showing who wants to talk | 🟡 | Effective to subtly indicate you want to say something, which might be helpful for some people, but might be too awkward to actually use | 🟢 | 🟡 | 🔴 | 🟢 |
| ⭐ Variable environment based on conversations | 🟢 | Could promote talking to people to see the environment change, but could feel bad if they are unable to actually pursue conversations | 🟢 | 🟢 | 🔴 | 🟢 |
| Idle game during conversations | 🟡 | Easy way to help some people focus more on the conversation, or ease out of a conversation. But could distract too much from the conversation | 🟡 | 🟡 | 🟡 | 🟢 |
| Light-based group game | 🔴 | Can help bring people together, but real connections might not be established | 🟡 | 🟡 | 🟢 | 🟢 |
| Variable environment based on movement | 🟡 | Could bring people together, but not necessarily maintain interactions | 🟢 | 🔴 | 🟢 | 🟡 |
| Study help add-ons | 🟢 | Can bring people together working towards a common goal, but could be a niche situation | 🟢 | 🟢 | 🔴 | 🟢 |

*Figure 4. Evaluation table of the main ideas*

The evaluation criteria were determined by the design requirements established at the beginning of this project, which are, in the order of importance:

1. it integrates seamlessly into high school students' everyday interactions
2. It promotes social interactions
3. It visualizes the interaction to make data collection easier
4. It is feasible to create a prototype in the given timeframe
5. It lowers the barrier of entry to social interactions
6. It is effective within these social interactions
7. It promotes physical movement

As can be seen in Figure 4, design requirement 3 is not listed within the evaluation criteria, as it is a requirement that can virtually be implemented with any idea, though additional brainstorming might be required.

The order of importance of these design requirements is based on the requirements of the project, as well as the subjective importance of the type of interaction required for this project. The most important evaluation criterion is whether it integrates into everyday life easily, as this could make the other evaluation criteria easier to achieve. Promoting physical movement is the least important criterion, as not many high school interactions are centered around physical movement, and there is no subjective motivation to create such a prototype.

Each main idea was evaluated per criterion, with either a green, yellow, or red circle. A green circle indicates it meets the criteria, a yellow circle indicates that it might depend on the setting and specific ideas, and a red circle indicates that it does not meet the criteria. The 6th design requirement was evaluated per idea based on hypothetical use cases and how students might feel when using the tool.

After evaluating each idea, two ideas had four green circles and one red circle, which were "a variable environment based on conversations" and "study help add-ons". Thus, to decide which idea to continue with and develop further, personal motivation and intrigue determined the final idea, which was "a variable environment based on conversations". This idea had the most creative freedom and more use cases than developing study add-ons. Especially since there are already plenty of study add-ons available to promote students finding study buddies or tutors to help with schoolwork.

The two favorite ideas that pertained to the final main idea were then selected once again for a final evaluation. Ultimately, a mix of the two ideas was determined to be the best course of action, and thus the final idea to develop became "a digital plant or display that represents the conversation and dynamically changes". This is still quite broad, so the idea was further developed into the following idea:

A projection of a tree in a social area of a high school will pick up conversations, and different elements of the tree will dynamically change based on these conversations. The different factors that could affect the tree could be the amount spoken, the volume of the students, the most used words, the different people talking, etc.

Based on the various design requirements mentioned earlier, this idea is able to meet these requirements quite well.

1. With a display or projection that passively takes conversations as input, it shouldn't be intrusive in their daily conversations and should just be a product of their interactions.
2. This idea should be able to promote social interactions, as the growing of the tree and the dynamic changes should spark curiosity within the students, making them wonder what it all means and how the tree will look like in the end. And if the students feel rewarded when they are able to directly and consciously influence the display, they might be more inclined to continue conversations.
3. With an interactive display that is influenced by the conversations, the conversations themselves are then easily displayed and understandable if you know what's going on. It is then also easier to keep track of data points by relating them to a visual element in or on the tree.
4. The idea is quite feasible to make, though it is further simplified, as described in the next chapter.
5. This display could calm students or even gamify the experience, making the barrier of entry to engaging in these conversations lower. With a constantly changing display, students could also choose to engage in the display or not, giving an element of choice and not pressuring students to interact.
6. The effectiveness of the idea will be tested during the playtests, which are described in Chapter 7.
7. The only requirement this idea does not meet is promoting physical activity, however, this is not a "hard" requirement, and considering the other design requirements are deemed more important, it was considered an acceptable criterion to miss.

# 5. Realization

The idea selected in the previous chapter is quite ambitious for the scope and timeline of this project, so for the prototype, these elements have been simplified. The final prototype involves a tree that grows based on the amount of talking (so how much is spoken), flowers that indicate the amount of silence detected in the last few seconds, leaves that "sway" depending on the frequency of the voices, and fruits that appear based on positive or negative reactive words.

The hardware used for this prototype is:

- A laptop, to run the program on and store the screenshot on.
- A microphone, to pick up the conversations, and serve as a visual indicator for the participants so they are aware that their voices are being picked up.

The prototype was made in Godot v.4.3., as it seemed the easiest to achieve what was necessary, especially since it works modularly, so adding different elements was easily done. The animation and all the assets were hand-drawn in Krita. The art style between the tree and the add-ons is deliberately different, so the elements could stand out against the tree base.

Each element represents a different measurable aspect of the ongoing conversation:

- The tree [Fig. 5]
  - The tree indicates how much is spoken overall during the conversation. The more is spoken, the more the tree grows. If no one is talking, the tree won't grow. As the growth of the tree is finite within the prototype, to simulate further growth, the tree base alternates between the last two frames.
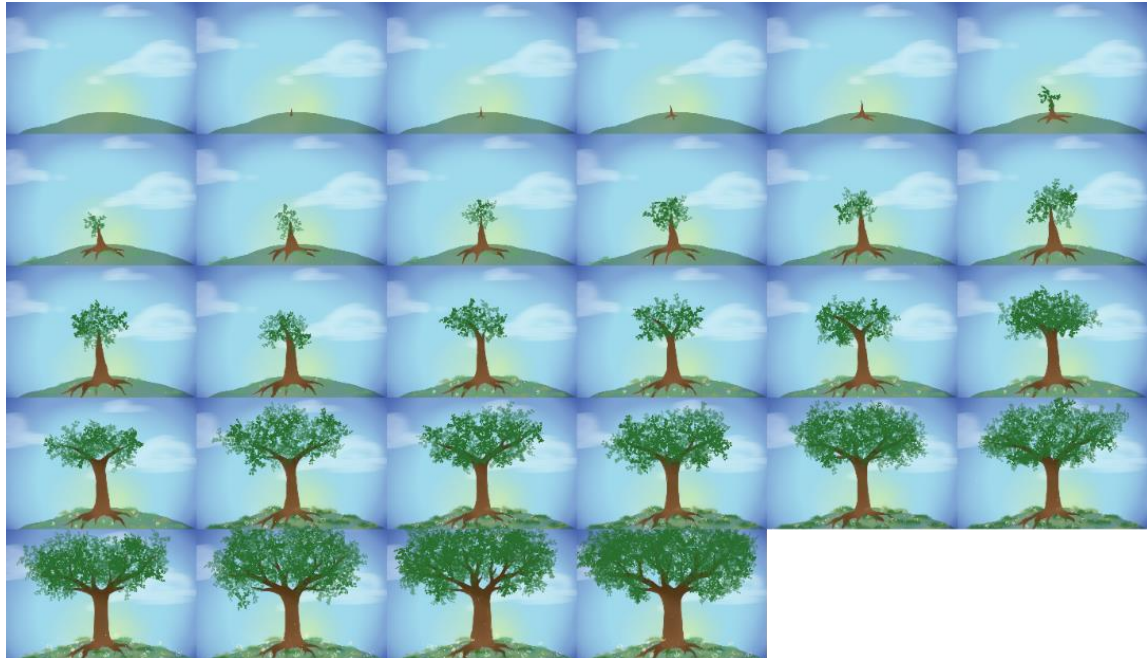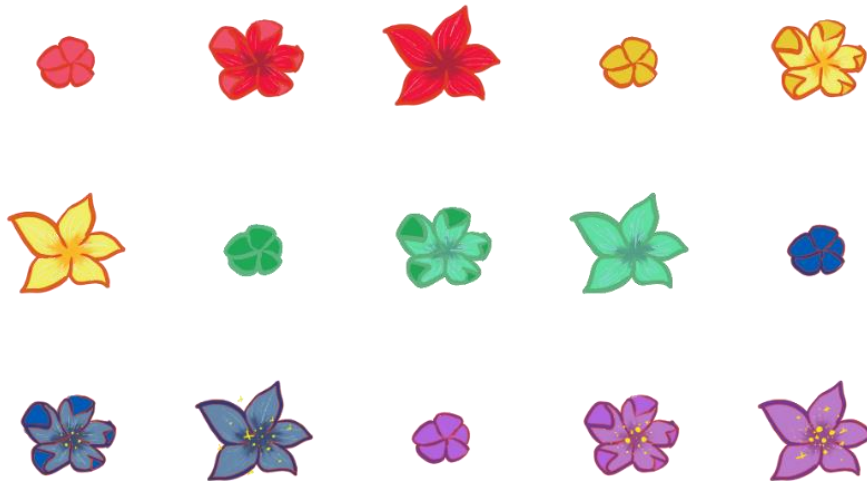


*Figure 5. Sprite sheet of the growing animation*

- The flowers [Fig. 6]
    - The color of the flower indicates the amount spoken since the last flower bloomed. Thus, a red flower represents total silence, or no talking was detected. The colors that indicate gradually more speaking are yellow, green, blue, and finally purple, where purple then indicates that constant speaking was detected. With this thus, it is reasonable to assume that most conversations would have a majority of green and blue flowers since most people might take a bit before responding, or have pauses when telling stories.



*Figure 6. Sprite sheet of the flowers' blooming animation.*

- The fruits [Fig. 7]
    - The fruits indicate reactionary words, with the type of fruit representing either positive reaction words or negative reaction words. In this case, the apple indicates positive reaction words, and the lemon indicates negative reaction words. Having reactionary words present in a conversation could indicate that a meaningful conversation is going on, or at least that people are listening to the speaker and are able to reciprocate and react to what the speaker is saying. Ideally, this program would make use of a speech-to-text software so these reaction words can be recorded automatically, however, due to difficulties implementing and problems with reliability, it was decided to 'Wizard of Oz' this functionality. The researcher then pressed buttons when a positive or negative reaction word was heard.



*Figure 7. Sprite sheet for the fruits.*

- The leaves
  - The speed of the swaying/movement of the leaves is based on the frequency of the voices speaking. There are different colored leaves visible, but this is mainly for variety and has no additional purpose in this prototype.
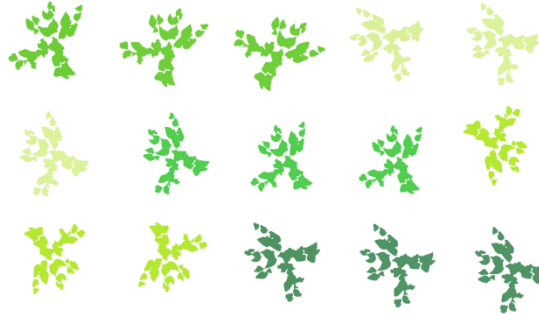


*Figure 8. Sprite sheet for the different leaves' animation.*

A final element that is added to the prototype is a particle system that is overlayed on the animation. Its main purpose is to add a moving element to the display, in case there would be long silences, in which not much would happen on the display. It also added some whimsy to the output.

To prevent playtest participants from feeling worn down by conducting a conversation for longer than they were comfortable with, the prototype has a 3-minute timer set, after which the animation will stop and a screenshot of the final tree will be made. This can be seen in Figure 9 which is the final screenshot of one of the pilot tests run.
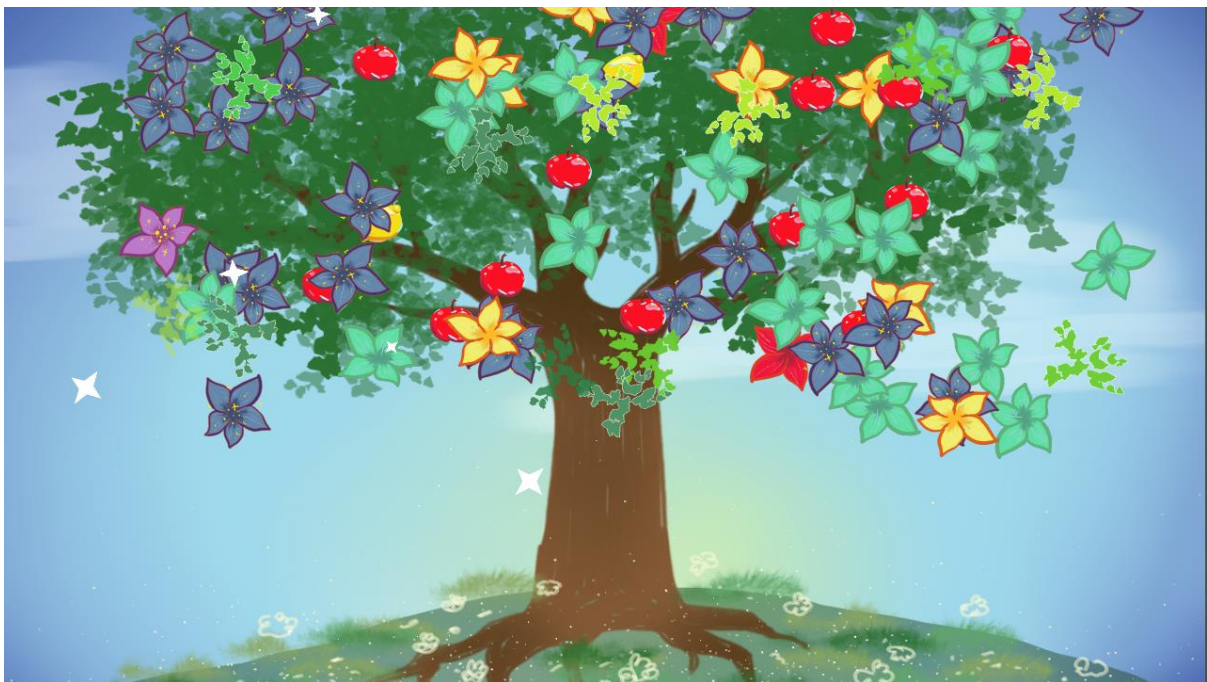


*Figure 9. The result of one of the pilot tests, depicting all the assets together at the end.*

# 6. Playtesting

Once the prototype was made, it was time to conduct some pilot tests. The procedure and results will be discussed below.

## 6.1 Procedure

During the playtesting, certain claims that have been made about the prototype will be disputed or confirmed by the participants. The main question we want to answer is: What kind of impact does the prototype have on the student during their conversation?

The claims that have been made and will be tested are:

- The prototype promotes conversational activities.
    - Due to the personalized tree that is a product of one's conversation.
        - Some might want to talk more to see what the outcome will be.
    - The ever-changing display could motivate people to not look at their phones, also providing a subtle distraction if they feel themselves losing track of the conversation.
    - With the display, some people might focus more on the conversation and have more meaningful conversations.
- It provides a positive impact and is beneficial to their conversation than without it.

The main tasks that are asked of the participants are:

- Conduct a conversation for 3 minutes.
    - If there are two participants, the researcher would not join in the conversation.
    - If there is only one participant, the researcher will conversate with the participant for the playtest.
- Answer a user experience questionnaire [16].
- Answer questions in a semi-structured interview with the researcher.

It was decided that the participants have a 3-minute timer for their conversation, as this would provide enough time for a bit of conversation but also enough time for the tree to develop in a significant way. The participants weren't, however, harshly cut off once this timer was done, and the researcher let their conversation subtly die down by also participating at this point, and steering the conversation to the next phase. Ideally, two participants would playtest at once, so they are able to conversate amongst themselves without the researcher.

Once the prototype was finished and the participants were done with their conversation, they were given a User Experience Questionnaire [16]. The User Evaluation Questionnaire (UEQ) was used to gain a preliminary insight into what participants think of the prototype. It measures 6 different aspects, attractiveness, perspicuity, efficiency, dependability, stimulation, and novelty. It helps in gaining an insight into the functionalities of the prototype, both task-related and non-task-related. Participants are then able to give their first impressions without overthinking, giving them a basis to expand upon in the interview.

The guided interview questions are as follows:

- What are your initial thoughts on the prototype?
- Are you able to describe what was happening during the playtest?
- What is your favorite part of the prototype?

- What is your least favorite part of the prototype?
- What kind of impact or effect did the prototype have on your conversation?
- What kind of impact or effect did you want the prototype to have on your conversation?
- What emotions did you experience during the playtest?
- Compared to your usual everyday conversations, did this playtest feel different in any way?
- If you had a magic wand to do whatever you wish, what would you change about the prototype?
- Any final feedback, questions, or suggestions?

The elements of the prototype and what they relate to are not explained beforehand, to determine whether it is understandable at first glance, or at least in the first few minutes. They will then be fully debriefed during the interview after asking them if they understand what was happening during the playtest.

## 6.2 Playtest Results

The conversation topics per playtesting pair were decided by the pair themselves, and as they knew each other well enough to feel comfortable conducting a conversation, their topics were not of note for the results of the tests. What is to be noted, is that they did not talk about the display extensively, and only some made remarks about it.

The User Experience Questionnaire (UEQ) gives a good impression of what participants thought of the prototype. The dataset can be seen in the Appendix, as well as the calculations. The UEQ measures 6 main categories: Attractiveness, Perspicuity, Efficiency, Dependability, Stimulation, and Novelty.

| UEQ Scales (Mean and Variance) | | |
| --- | --- | --- |
| Attractiveness | ↑ 1.405 | 0.45 |
| Perspicuity | → 0.429 | 1.81 |
| Efficiency | → 0.500 | 0.48 |
| Dependability | → 0.429 | 0.93 |
| Stimulation | ↑ 1.000 | 0.42 |
| Novelty | ↑ 0.929 | 0.62 |

These categories can be further divided into pragmatic (Perspicuity, Efficiency, Dependability) and hedonic quality (Stimulation, Novelty), which describe the task-related quality and non-task-related quality respectively. Very clearly, the hedonic quality is quite high, but the pragmatic quality is lacking, and average at best.

The results of the UEQ are confirmed and elaborated on in the interview. Most participants pointed out that they liked the look of the animation. Five participants regarded the assets, the flowers, and the animation of the tree, as their favorite part of the prototype. One participant remarked that the prototype gave them a "sparkly" and positive feeling when seeing it while conversing.

Meanwhile, it was very clear that most participants were confused by the prototype. Most were able to discern that it had something to do with their conversation, they were slightly off in their

guesses. These same participants played a bit with the prototype in the first few minutes of the playtest, after which they focused on the conversation at hand. Some tried speaking a bit louder than usual, others tried rambling on to see if that made a difference, and some tried emphasizing certain keywords. Some students, however, fully ignored the prototype and were just pleasantly surprised when they saw the end product. With this, it is clear that what the prototype was doing and measuring was confusing for most participants.

The feelings that participants noted were curiosity, reward, confusion, happiness, and overwhelm which for some led to ignoring the prototype. As mentioned before, some participants played with the prototype, so felt rewarded when they visibly saw that they were able to influence the display, e.g. rambling on caused the color of the flowers to change. These efforts and thus feelings were individual, as none of the pairs joined together in trying to influence the prototype.

When asked what kind of impact the prototype made on their conversation, it differed greatly per person, regardless of who they had their conversation with. Some participants were positively impacted by the prototype, where they enjoyed the accompaniment of a "cute and calming" display. Others didn't pay any attention at all to the prototype, thus it didn't have any effect on them. And other participants were distracted by the display, similar to how they would be distracted by their phones in their usual conversations. They also remarked that they felt like their conversation was being graded, both positively and negatively. Hypothetically, if you had a "good" interaction, the conversation was flowing and the participants had fun, it would feel good to look at the tree and see mostly blue and purple flowers with a lot of fruits. But if it was a "bad" interaction, filled with awkward silences and stilted conversation, it would feel worse to see that reflected in the tree. There would be some cases where one might feel relieved when they think that they've been silent for too long, and look at the tree expecting to see a red flower, but instead, it's a green flower.

This distraction and also overwhelm was mainly due to the animation and the assets. While it was remarked that the assets and animation were pretty, the process of the display was remarked as negative. The animations played quite quickly, and there was constantly something going on. Because the assets popped up quite frequently in the 3-minute timeframe, by the end the tree was completely covered in flowers and overlapping. The display was thus overstimulating for most participants, which either led to distraction or them ignoring the display.

The conversation they had during the playtest was mostly remarked to feel more or less the same as their regular conversations. While there were feelings of comfort, this impact was too mild to indicate a significant effect. And some were distracted, but remarked that they also get distracted in their usual conversations, seeking out stimulation so they can try and focus back on the conversation. So for some, it is not too different than looking at their phone or stimming [17] in some way in their day-to-day lives.

Figures 10 – 14 depict the final screenshots taken from each of the pilot tests.

*Figure 10. Final screen shot of "Pilot test 1".*



*Figure 11. Final screenshot of "Pilot test 2".*



*Figure 12. Final screenshot of "Pilot test 3".*



*Figure 13. Final screenshot of "Pilot test 4".*

# 7. Discussion

## 7.1 Pilot Test Results

From the UEQ, it is very clear that the prototype did not have much impact on the conversations. The pragmatic quality was deemed as quite average, neither bad nor good. This can be explained by the confusion that some people experienced, and by the participants who did not take note of the prototype at all. As they did not know what the prototype was supposed to do, and it didn't intrude on their conversation, it is understandable that they didn't remark it as supportive or motivating to their task. As it was also distracting, it was remarked it in some ways it was detrimental to their task. It was deliberately chosen to not explain the full details of the prototype, to find out whether it was understandable at a glance. Very clearly, it was not clear. While some might've had an inkling, the prototype was too vague in what it was doing to be understandable to the participants and thus have an effect on them. The important design aspect of the prototype was to integrate seamlessly into their daily conversations. It is a bit unclear whether this was achieved, as no clear impact was determined. In some cases, the prototype was too much of a presence causing a distraction, but in others it was forgettable. In two cases, however, the prototype seemed to be integrated well into the conversation the participants took note of the prototype throughout the conversation, and felt that it had a positive effect. However this is not enough to conclude that the prototype integrated well into the environment. It did offer the option to opt in and opt out, but most people opted to go for either extreme, which was not implicitly intended. Ideally, participants would occasionally look at the display, or "feel its presence" and gain a positive effect which would in turn affect their conversation. This scenario is quite vague and idealistic, so it makes sense that the outcome was not what was expected, however with more testing and changes to the prototype it might be possible to achieve an outcome that is close to that scenario.

Looking at the final result of each of the pilot tests, they are successfully distinct enough from each other. You could also reasonably make assumptions about their conversation and maybe how they speak. "Pilot test 2" and "Pilot test 3" are quite different, where in "2" there are more yellow flowers, which indicates more pauses between people speaking, and in "3" there are a significant amount of blue flowers, which indicates fewer pauses. This could be due to excitement of the topic, or participants not needing too much time to think about what they want to say. However, because of the density of the assets, it is difficult to make out the specific details, especially the fruits, which is not optimal. The diversity in assets, as well, can make all the final results look quite similar at first glance, which was not the goal of the prototype. Having more diversity could lead to more unique trees that stand out from each other.

## 7.2 Limitations

It is also not clear if the prototype is the right type of tool to aid in students' conversations. It was tested with university students, who admitted themselves, that they might not need such a tool now that they have more social skills than they had in high school. They were able to try and think back to how they would react to the prototype when they were high schoolers, but it's not reliable enough to determine if it would be liked by them. A concern one of the participants had, was their privacy being breached in such a setting. Since a microphone is picking up their voices, recording and processing them, it would be worrying if the conversations are recorded and used maliciously. During the playtest it was made sure and emphasized that their conversation would not be recorded, but the cause for concern is understandable. This would

have a large negative effect on participants, as they would not feel comfortable talking, in fear of it being used and known by others.

Only pilot tests were conducted because of the time constraints, so university students were asked to participate. Moreover, it was ensured that they did the playtest with their friend to prevent uncomfortable or awkward conversations and encounters. So only one type of environment and encounter was tested during this project, which limits the feedback and results. However, it still provides enough results to work off of for future research.

The end prototype was designed to be integrated into conversations, as conversations are an activity that most if not all students partake in. However, there are other activities that they do as mentioned during the field research, and thus it is possible that a different activity might suit this tool better.


## 7.3 Future Recommendations

There were many recommendations and feedback provided by the participants that could be implemented in further iterations and research that could help achieve the goals strived for in this project. Aside from the quick fixes to the current prototype, which are slowing the animations down, preventing overcrowding of assets, and making animations clearer and less overstimulating, there were recommendations to enhance the prototype. One suggestion was adding audio to fill any silences, making it less awkward and making it easier to pick up the conversation again. Another recommendation was creating a tree sculpture with LEDs that reacted to conversations around it, maybe even swaying along with the conversations. This then might have more of a presence in a room than a simple projection. A suggestion was making the tree appear on phones, where students who are conversating would put their phones in the middle, and their phones would act together as a screen for the tree to show up on. This could then motivate students to not be on their phones during the conversation and focus. While this prototype is designed for high school students to use, it is not specifically geared towards them, and could potentially be used in a variety of settings, such as therapy or classrooms.

As only pilot tests were conducted, it is advised that the "quick" fixes are implemented to the prototype first before conducting a full playtest. There were also only 7 participants, which means that one of them had to have the conversation with the researcher, which is not ideal for actual playtesting purposes. Thus, for further testing, more participants should be asked to partake, and random pairs should be made to account for most interaction scenarios. It is up to the researcher's discretion whether they give the full context of the prototype to the participants, as there are benefits to explaining it thoroughly beforehand or debriefing them afterward.

# 8. Conclusion

There are many factors why high school students avoid social interactions; they aren't confident in their social skills, they aren't able to connect with peers, or they simply prefer being alone than with a group of people. Nonetheless, having minimal social interactions could lead to a deterioration of one's overall well-being, but especially their mental health. The prototype that was designed during this project aimed to promote conversational activities, as conversations are an activity that every high schooler does during their breaks. The prototype involved an animated tree that grows and changes, influenced by the conversation. Pilot tests were done with university students and the results are inconclusive. While the prototype had a positive impact on some, for most it was too distracting to focus on the conversation, or it was too overwhelming that they didn't pay attention to it. For future research, if planning on using this project's prototype, it is advised to implement the animation suggestions before testing. While the prototype might not have had a significant impact on conversations, it is still the right step in helping students interact more with their peers.

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# Appendix

## Use of AI

During the preparation of this work the author used Grammarly in order to check for spelling and grammar mistakes. After using this tool, the author reviewed and edited the content as needed and takes full responsibility for the content of this work. No other AI tools were used.

## A. The Miro Board



*Figure 14. The Convergence Phase*
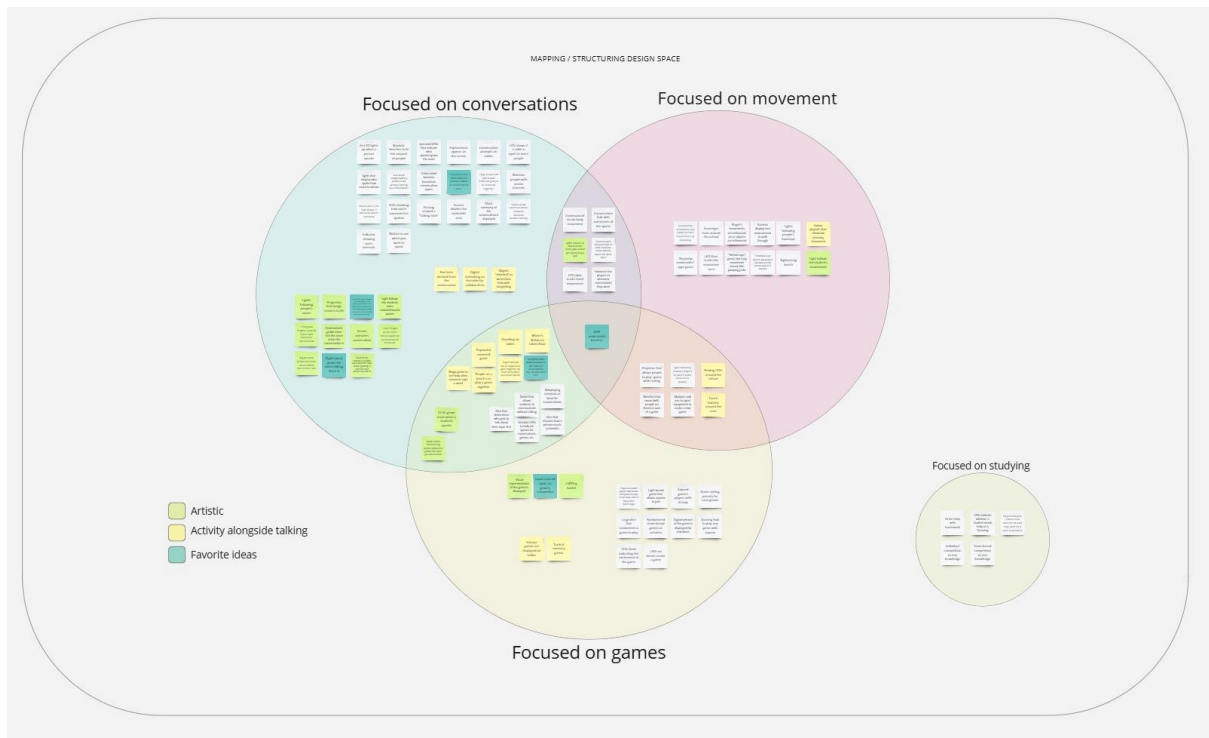
*Figure 15. The Divergence Phase*



*Figure 16. Evaluating the main ideas*

Projector

Computer screen can be used if projector can't be procured

Group conversation

Keep the conversation between two people to show the functionality, one person if need be

Tracking previous and current events

Only track the current conversation

Growing plant based on conversation

Instead of various aspects of the plant growing or appearing, only two or three aspects appear, based on e.g. how long they talk, how loud, how many times they laugh, etc.

Idea:
Use microphones to record their conversation, using a transcriber or something similar. Might be easier to have every person have a separate microphone if individual data is needed, for possibly easier processing. With the transcriptions, data could be extracted, like which words do they use the most, possibly what is their mood while talking. "Simple" data could also be extracted, like how much they talk (in comparison to the other person talking), how loud they talk, how fast they talk, etc.

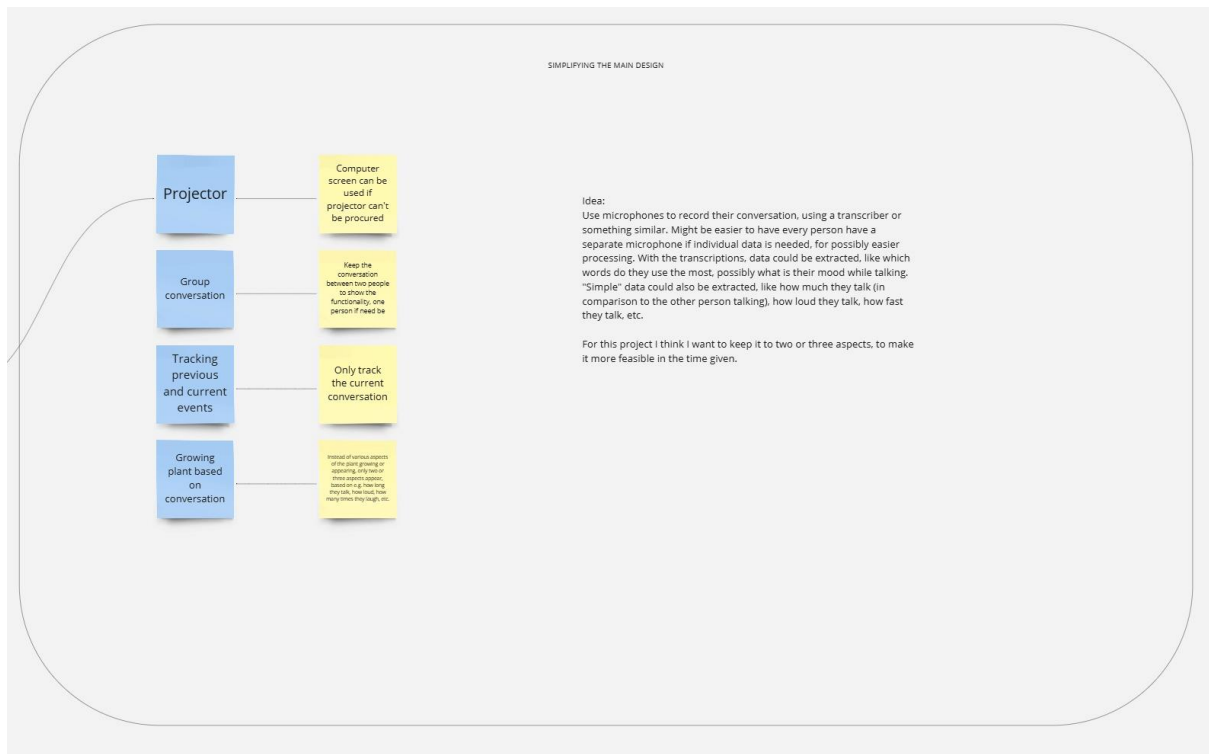For this project I think I want to keep it to two or three aspects, to make it more feasible in the time given.

*Figure 17. Simplifying and expanding the final idea*

# B. The Questionnaire

# The Social and Active Life of High School Students

**Nederlands hier beneden**

Dear participant,

Thank you for participating in this survey.
This survey will contain questions focusing on your high school life, more specifically your social life and what you do during your breaks. It's part of a larger research project that aims to create a tool that helps high school students socialize more and get more active.

Answering this survey will take around 5 minutes. I would like to emphasize that your participation in this survey is completely voluntary and that all answers will be processed confidentially and anonymously. You can have your responses deleted at any time without a reason.

If you have any questions about the survey or the research, don't hesitate to contact me via my email: a.m.benthem@student.utwente.nl

***
Geachte deelnemer,

Heel erg bedankt dat je mee wilt doen aan deze survey.
Deze survey bestaat uit vragen die betrekking hebben tot je middelbare school leven, specifiek je sociale leven en wat je doet tijdens de pauze. Dit is deel van een groter onderzoeksproject dat een hulpmiddel probeert te maken zodat middelbare studenten meer socializeren en bewegen.

Het beantwoorden van deze survey duurt ongeveer 5 minuten. Belangrijk om te weten is dat je willekeurig mee doet, en dat alle antwoorden confidentiaal en anoniem worden behandeld. Als het nodig is, mag je vragen om je antwoorden te verwijderen zonder reden.

Als je vragen hebt over de survey of het onderzoek, mag je gerust contact opnemen met mij via email: a.m.benthem@student.utwente.nl

* Indicates required question

1. Choose a language/Kies een taal *

   *Mark only one oval.*

   ⬭ English

   ⬭ Nederlands      *Skip to question 14*

   Consent

2. Do you consent to your responses being used in this research? *

   *Mark only one oval.*

   ⬭ Yes

   ⬭ No        *Skip to section 7 (Thank you)*

   Tell me about yourself

3. How old are you? *

   *Mark only one oval.*

   ⬭ 15 or younger        *Skip to section 7 (Thank you)*

   ⬭ 16

   ⬭ 17

   ⬭ 18

   ⬭ 18+

4. Which gender do you identify with? *

   *Mark only one oval.*

   ⬭ Male

   ⬭ Female

   ⬭ Nonbinary

   ⬭ I'd rather not say

School

5.    Are you currently enrolled in high school? *

*Mark only one oval.*

◯ Yes

◯ No      *Skip to section 7 (Thank you)*

About your school life

This section will be about what you do during your school breaks, whether alone or with friends. Take your time answering these questions. Here's a reminder that your answers are anonymous, and if you have questions don't hesitate to email me at a.m.benthem@student.utwente.nl

6.    What are some activities that you usually do during school breaks? *

_____

_____

_____

_____

_____

7.    What are some activities you see other people doing?

_____

_____

_____

_____

_____

8.   Are there any activities you see others doing you **want** to participate in? *

_____
_____
_____
_____
_____

9.   Are there any activities you see others doing you **don't want** to participate in? *

_____
_____
_____
_____
_____

10.   Are there any activities you see others doing that you **can't** participate in? *

_____
_____
_____
_____
_____

11.   Why are you unable to participate in these activities?

_____
_____
_____
_____
_____

12. What activity do you think could be improved upon? *

_____

_____

_____

_____

_____

13. Would you like to input your email so you could possibly get picked to do a short interview with me? Only a few will be randomly selected for this interview.

_____

Thank you

Thank you very much for participating in this survey!
If you have any questions or want your responses deleted, don't hesitate to contact me: a.m.benthem@student.utwente.nl

Thank you

Thank you for wanting to participate in this survey, however, you are unfortunately not within our target group. Hope you have a nice day!

Consent

14. Geef je toestemming dat je antwoorden gebruikt worden voor dit onderzoek? *

*Mark only one oval.*

◯ Ja

◯ Nee       *Skip to section 13 (Dankjewel)*

Vertel me over jezelf

15.    Hoe oud ben je? *

*Mark only one oval.*

⬭ 15 of jonger      *Skip to section 13 (Dankjewel)*

⬭ 16

⬭ 17

⬭ 18

⬭ 18+

16.    Met welke gender identificeer je jezelf? *

*Mark only one oval.*

⬭ Man

⬭ Vrouw

⬭ Nonbinair

⬭ Dat zeg ik liever niet

School

17.    Zit je nu op de middelbare school? *

*Mark only one oval.*

⬭ Ja

⬭ Nee      *Skip to section 13 (Dankjewel)*

Over je schoolleven

Deze sectie gaat over wat je doet in de pauzes, of alleen of met vrienden. Neem je tijd wanneer je de vragen beantwoordt. Nog een herinnering dat je antwoorden anoniem zijn, en als je vragen hebt kan je mij contacten via a.m.benthem@student.utwente.nl

18. Wat voor activiteiten doe je tijdens de pauze? *

_____

_____

_____

_____

_____

19. Wat voor activiteiten zie je dat andere mensen doen? *

_____

_____

_____

_____

_____

20. Zijn er activiteiten die je anderen ziet doen waar je **wel** aan mee wilt doen? *

_____

_____

_____

_____

_____

21. Zijn er activiteiten die je anderen ziet doen waar je **niet** aan mee wilt doen? *

_____

_____

_____

_____

_____

22.  Zijn er activiteiten die je anderen ziet doen waar je **niet kan** mee doen? *

\
\
\
\
\

23.  Waarom kan je niet meedoen aan deze activiteiten?

\
\
\
\
\

24.  Welke activiteit denk je dat beter kan zijn? *

\
\
\
\
\

25.  Wil je je email adres invullen om misschien een kort interview met mij te willen doen? Alleen een paar mensen worden gekozen.

\

Dankjewel

Heel erg bedankt dat je mee hebt gedaan aan deze survey!
Als je vragen hebt of je wilt je antwoorden verwijderen, neem contact met mij op:
a.m.benthem@student.utwente.nl

Dankjewel

Dankjewel dat je mee wilt doen aan deze survey. Helaas zit je niet binnen onze doelgroep.
Fijne dag verder!

---

Google Forms

# C. Consent and Information Sheet for the Playtests

**Consent and Information Form for the Playtest**

This session will take between 5 to 10 minutes to complete.

In this playtest, you will be having a conversation with another student about a topic of your choosing. This conversation will be recorded and used to create a digital representation of the conversation.

Information regarding your name will be collected. You have the right to request access to and rectification or erasure of personal data at any time. This data will only be used during this study and will be destroyed when the study has been completed. The data collected in this playtest will be used for a research project that I am working on for my Graduation Project. The aim of the project is to make a game that will aid high school students in interacting with their peers, and making these interactions more visible.

You have the right to stop the playtest at any time and request the destruction of any data gathered up until that point.

| *Please tick the appropriate boxes* | Yes | No |
|---|---|---|
| **Taking part in the study** | | |
| I have read and understood the study information dated --/01/2025, or it has been read to me. I have been able to ask questions about the study and my questions have been answered to my satisfaction. | O | O |
| I consent voluntarily to be a participant in this study and understand that I can refuse to answer questions and I can withdraw from the study at any time, without having to give a reason. | O | O |
| I understand that taking part in the study involves an audio recording that will be transcribed and the recording destroyed upon completion of the study. | O | O |
| **Use of the information in the study** | | |
| I understand that personal information collected about me that can identify me, such as where I work or live will not be shared beyond the study team. | O | O |
| I agree that my information can be quoted in research outputs | O | O |
| **Consent to be Audio/video Recorded** | | |
| I agree to be audio/video recorded. | O | O |
| **Future use and reuse of the information by others** | | |
| I give permission for the thoughts and ideas that I provide to be archived in anonymised transcripts so it can be used for future research and learning. | O | O |

**Signatures**

_____    _____ _____
Name of participant/guardian [printed]

                                                Signature                        Date

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

_____    _____ _____
Researcher name [printed]                      Signature                      Date

**Study contact details for further information:  Alyson Benthem – a.m.benthem@student.utwente.nl**

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

If you have questions about your rights as a research participant, or wish to obtain information, ask questions, or discuss any concerns about this study with someone other than the researcher(s), please contact the Secretary of the Ethics Committee Information & Computer Science: ethicscommittee-CIS@utwente.nl