Interactive installation for an Educational Ethics Lab

Bachelor Thesis

University of Twente, Creative Technology

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Abstract

Ethics is very important for students to learn about. Teaching ethics to students makes them able to make their own independent decisions about right and wrong. To make students aware of ethics, the Lectorate of Ethics and Technology from the Saxion University of Applied Sciences wants to create an educational Ethical Lab, where people should be inspired to think about ethics. In this lab, multiple interactive installations should be there to let students experience old classical ethical dilemmas for themselves. This creates a form of active learning which is much more effective than the standard passive learning in classrooms. The chosen ethical dilemma for this project is The Allegory of the Cave by Plato. For this project an interactive installation was created where the user is framed with very one-sided information about Egypt, the user's opinion is unconsciously influenced into believing Egypt is doing well, when in fact, it is absolutely not. When evaluating this installation with potential end users, the participants realized that the installation had, unknown to them, changed their opinion. This effect of propaganda is very relatable to the Cave of Plato where the one-sided news is the shadows on the wall, the confrontation with the framing is the outside world and the user of the installation is the prisoner. However, the users would not change their behavior when presented with news articles. As Plato already stated in his theory, the prisoners in the Cave will rather accept reality as is presented to them, than work hard to find out the actual truth.

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1. Introduction

Our global society can benefit from the impact of ethics. Nowadays, ethics is used in all industries. For example, making marketing professionals aware of the importance of ethics improves their social responsibility and ethical intention positively. But also, businesses have implemented a "Code of Conduct" to give their vision about good and bad behavior. That is why ethics should be taught to students. In these courses, students are given free will to make decisions by teaching ethics to them. The Saxion University of Applied Sciences has a Lectorate of Ethics and Technology that researches ethics from a practical point of view. This Lectorate explores the widespread impact, ethical consequences, advantages, and disadvantages of (future) technologies. The Lectorate wants to create new and innovative ways to let people experience the dilemmas raised in classical ethical problems.
There are no physical, interactive installations created to really let people experience this kind of ethical dilemma. Therefore, the challenge for this project is to develop an interactive exhibit or installation that demonstrates or lets people experience a classical ethical dilemma. The Saxion in Deventer has made a room available for the Lectorate and this project. In this room, multiple physical installations should demonstrate or let people experience a classical ethical dilemma.

Therefore, the main research question is: How can a physical, interactive installation impact the user's awareness of ethics?

The following sub-questions are important to answer the main question:
Why is being aware of ethics important?
How can a physical, interactive installation create the experience of an ethical dilemma?
How is the classical ethical dilemma still important in today's society?

The first part will be background information about the project and background research on the topic. The second part will be the ideation phase and the generation of concepts for the final design.

2. Background

2.1 Context

2.1.1 Ethics Lectorate

Nowadays, ethics is in some cases taught to students. Results from interviewing students from Intermediate Vocational Education, Higher Vocational Education, and University, it turned out that only two of the six participants had an explicit ethics course in their study program. Ethics is taught to students in the form of passive learning. This means that students have to observe the information that is presented by them during college. At this moment, there is no place where students can actively participate in understanding ethical questions.

This problem was also found by the Lectorate of Ethics and Technology of the Saxion University of Applied sciences. They want to create a more practical approach to ethics. They envision an "Ethics Lab", as a physical space that is dedicated to ethical reflection on the impact of technologies. In this lab, students should be stimulated to ethical deliberation and experimentation. This lab should have Interactive Installations which should let the user experience an old "Classical Dilemma". Students have to interact with these installations to get some historical background for ethical reflection.

In collaboration with the Ethics Lectorate, multiple classical ethical dilemmas were discussed as possible options to use in an interactive installation. Based on personal preferences, an ethical dilemma was chosen for the project, which for this project is The Allegory of the Cave by Plato.

2.1.2 The Allegory of the Cave by Plato

Ethics is not new to mankind and has played an important role for many years already. Around 380 BCE, philosopher Plato wrote his most famous theory: The Allegory of the Cave [1], see also figure 1. His theory is about prisoners chained down in a cave. They have been in that cave for their whole life and they have been tied down and their heads are stuck in one direction, so they are unable to look around. Behind them is a fire and puppeteers that hold objects over a screen so that their shadows from the fire are cast on the cave's back wall. Because the prisoners have never been in the outside world but have only seen the shadows on the wall, they preserve the shadows as the "reality". They believe the shadows of objects cast by the moving figures are real things - and the only things [2].

Plato then poses the question: What would happen if one of the prisoners was released from his chains and allowed to turn his head? [3]. The prisoner would then see that the shadows are just representations of real objects. He would then know that the shadows are not the "real world". Then Plato asked himself: "What do you think he would say, if someone told him that what he saw before was foolery, but now he saw more rightly, being a bit nearer reality and turned towards what was a little more real?... Don't you think he would be puzzled, and believe what he saw before was more true than what was shown to him now?" [3].

Also, if the prisoner would escape from the cave, his eyes would hurt from the daylight and therefore he would want to look back at the shadows on the wall again. Only after some time, he would be able to see anything from the outside world.

The allegory is about the perception of reality. Plato's idea is that the world we perceive as humans is only a dim representation of the real world [4].

Figure 1: Plato's Cave

2.2 Background research

2.2.1 Why is learning about Ethics so important?

By teaching ethics to students, students are provided with the ability to make their own independent decisions. A study by Gülcan [5] divided learning ethics into four different stages:

1. Ethics education in family
2. Ethics education in school
3. Ethics education in university
4. Ethics education in business

The first stage is about children observing their parent's ethical behaviors and learning their social facts. Ethics in school is all about learning what is right and what is wrong. Students should learn value clarification and make ethical decisions. Ethics in university is also about learning right and wrong, but now in the professional field. Not all studies support an ethics course, but it can help students to learn about good decisions regarding ethical issues and morals in their professions. Ethics in business is about telling people how they should act in business life.

Gülcan concludes that ethics is about creating a free will. He states that it is easy to teach students norms, but it is hard to teach them to obey these rules. That is only possible when you teach students about ethics. A study by Hazarika [6] also points out that ethics in education is very important, especially as new technological changes and development are taking place. Gluchmanova [7] agrees on the importance of ethics in education and adds to this that ethics can develop a critical stance toward some of the most pressing ethical issues in education in contemporary societies. Students will also be more aware of their own culture and other cultures. Gülcan also points out the fact that ethics can be related to religion, depending on the country you live in, and thereby learn about the ethics within that religious culture.

2.2.2 Ethics in business

Ethics is not just a theoretical subject that students should learn in school to make personal decisions. Ethics is later in their lives also crucial in lots of business sectors. Companies have created a "Code of Conduct" to give their vision about good and bad behavior [8]. Adam [9] states that the informal implementation of these codes can greatly influence workers in a company. Green et al. [10] did research on this and looked into how the Code of Conduct of the AICPA (American Institute of Certified Public Accountants), which also very strongly emphasizes the importance of education in ethics, would have an effect on students within this institute. They found no significant difference in moral reasoning before the auditing course. But students who had finished the course resonated at higher levels than students who had not taken the course.

2.2.3 The allegory in today's society

Plato's theory about the perception of reality is related to today's society with the use of social media. Many people nowadays are using some kind of social media. People are shown a representation of the real world that people will preserve as reality, just like the shadows in the cave. Major [11] concluded in his master thesis that social media is indeed corrupting the perception of reality.
According to a study by Zhuravskaya et al. [12], social media has a big role in spreading fake news and propaganda which are used by autocratic regimes to censor the Internet and to use social media for surveillance and propaganda. In this way, dictators can control what information their citizens have access to. With this, dictators can make the reality in their country appear different and often better to their inhabitants than the situation actually is. This is also found in a study performed by Huang et al. [13]. They state that not only is online propaganda used to influence their beliefs about the government, but it is also even framed that people who resist the government, are the ones who actually have been framed. As a result, they will see the other side as not real and therefore are unwilling to protest themselves.

Not only a political view is the perception of reality on social media different from the real world. A study by Gonzales et al. [14] found that people like to represent themselves more positively on social media. This finding is supported by a study by Strano [15], who looked at profile pictures and concluded that people tend to change their profile images more often and emphasize friendship in the images they choose to display. The positive representation can be seen as just the "shadows" in Plato's cave because the more negative personal sides are left behind an not seen by the public so they will get a different perception of the actual person. The full personality can be seen as the real outside world in Plato's allegory. However, according to Hülcen Dönmez et al. [16], students are also aware that information online cannot be seen as the full truth. They know that there is more than just the "shadows on the wall". A study by Luo et al. [17] also found that people are likely to judge news headlines on social media as fake. But they also found that people can distinguish fake news and real news on social media only with approximately 51% accuracy, which indicates that people are still falling for fake news.

The internet allows people to do more research about the world and retrieve more information about reality. That is why Pouyioutas [18] is stating, opposite to the other researchers, that the internet can be seen as the "liberator of the prisoners" instead of just the shadows of reality.

2.2.4 Active learning

By using an interactive installation to let students experience a classical dilemma, students will learn more from that experience than a normal lecture would. In the early 1960s, the Learning Pyramid was invented by the National Training Laboratories (NTL) for Applied Behavioral Science [19]. This model was made to represent the difference between active and passive learning in a pyramid shape. However, other researchers evaluated the paper, and they found lots of problems with the statements made in the Pyramid. The measurements were not done correctly and lots of assumptions were made. Letrud [20] states that the learning pyramid lacks empirical evidence, and any attempt to perform empirical tests of the model will encounter major methodical problems. Baer [21] agrees with this statement and states that because of this lack of empirical evidence, the validity of the Pyramid should be questioned.
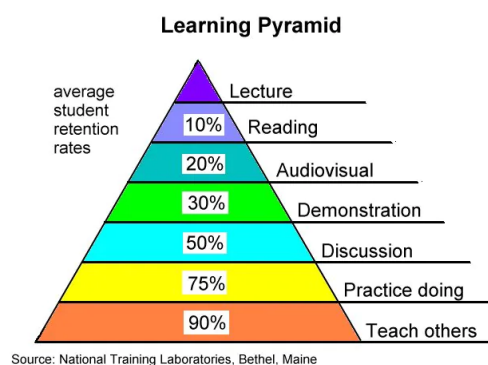
Figure 2: Learning Pyramid

However, after the creation of the Learning Pyramid, there is a lot of research done about the actual effectiveness of active learning in comparison to passive learning. Prince [22] states that active learning in many ways improves the learning skills of students. Minhas supports this and shows in his study that students' results and enthusiasm for active ways of studying improved significantly. By using an interactive installation to let students experience Plato's Cave, they have an active learning experience. Plato's theory will probably be remembered better by the students than by just providing the theory in a standard lecture.

2.3 State of the art

2.3.1 Paintings

There are multiple artists who have implemented Plato's Cave in their paintings to visualize his theory. Most of the paintings present a very literal version of the Allegory, as can be seen in figures 3 and 4. People are really held prisoner in the shadow of a wall or cave. Behind this wall is the bright sunlight in the real world. These artworks are a literal visualization of Plato's Allegory.
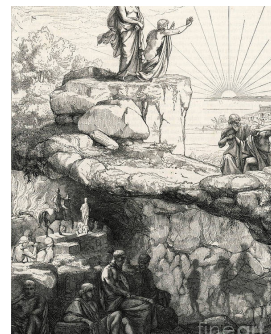
Figure 3: Cave Of Plato, Jan Saenredam   *Figure 4: Cave Allegory of Plato by Mary Evans*

There are also more abstract paintings created of the Cave as can be seen in figure 5. Artist Nicole Besack used layered veils of color to create the luminous effect of this veil painting. In this painting, a "prisoner" can be seen in blueish colors on the right side of the painting. He is looking into the brighter yellowish colors, which represent the sunlight from outside the cave.
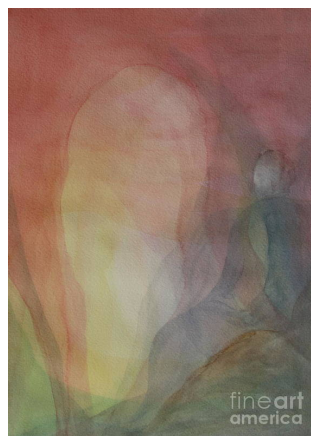
Figure 5: The Cave Veil Painting by Nicole Besack

2.3.2 Movies

2.3.2.1 The Truman Show

The Truman Show is a great representation of Plato's Cave. The film is about a man, called Truman, who lives on an island. That island is not part of the real world, in reality, a giant film set where he is filmed and watched by millions of people all over the world 24/7, and all the other people on the island are actors. All actors and environmental changes are controlled by a film director. But Truman does not know this and assumes that the island he is living on is the real world.
There are a lot of similarities between the Truman Show and Plato's Cave. In this case, Truman is the prisoner in the cave and is the only one ignorant of the fact that nothing in his world is real. The director, Christoff, says in the movie "We accept the reality
of the world with which we are presented." This is very similar to Plato's description of the chained prisoners when he says, "such persons would certainly believe that there were no realities except those shadows of handmade things." [3]. The message, just like Plato's message is, why question the only existence you have ever known? Later in the movie, Truman is realizing that his own reality is falling apart and begins to look for answers. He has to overcome his fears and abandon his friends and family to find the truth. He eventually tries to escape his own cave and gets very fearful and cautious when he reaches the actual wall of the film set, just like Plato envisioned. Christoff tries to convince Truman to stay in the film set because that is his safe world and thinks that Truman will be too afraid to leave his "cave". But in the end, Truman decides to leave the cave and can then for the first time see the actual reality.

2.3.2.2 The Matrix

The most direct representation of Plato's Cave is the famous movie The Matrix. In this movie, the main character Neo, and most other humans are living in a virtual world. That world is called the matrix. This virtual world is created by computers and Artificial Intelligence. The people are kept in this virtual world to create energy that is used by machines. However, the people in the matrix don't know that they live in a fake world. They perceive the world around them as the truth. There is only a small group of people who have been freed from the matrix, and try to free the rest of the people from that virtual world. Neo gets freed from the matrix by Morpheus and gets told that everything he knows is fake. Morpheus asks Neo: "Have you ever had a dream, Neo, that you were so sure was real? What if you were unable to wake from that dream? How would you know the difference between the dream and the real world?" [3]. They discuss the actual meaning of truth. Neo gets very upset after realizing that his whole life was fake and screams that he wants back to his old and normal life. Just like Plato's description of a freed prisoner of the cave. "all this would hurt him, and he would be too much dazzled to see distinctly those things whose shadows he had seen before... Don't you think he would be puzzled, and believe what he saw before was more true than what was shown to him now?".
The correlation with Plato's Allegory is very obvious throughout the whole story. Neo is the prisoner who is let out of the cave and into the real world. The real world exists outside of the

Matrix, which is represented by the cave. The puppet masters who dupe people into thinking the Matrix is real are artificial intelligence computers. The shadows cast on the wall in front of the cave inmates are all that the humans in the matrix can see. Everything is a manufactured, artificial reality. The red pill that Neo finally swallows to free himself from the Matrix releases him from the cave's bonds.

2.3.3 Image stream installation

Marchese et al. [23] created an installation that projected a live video stream of a place in the neighborhood. This projection was placed in offices or hallways where no windows or other views of the outside world were created to create a sense of space. The projected image on the wall felt like a window view for the users, despite the fact that they knew that it was just a projection. People think about the projected image stream as they approach the office, just like the freed prisoner thought about the prisoners left behind with the shadows in the cave. The image that can be seen on the wall is only a deprived version of the real streets and even of the cropped view from the corner office. Even though people are aware of the unreality of the image stream, they still need it for their sense of space. One viewer commented at the end of the day that now she was going outside to the real thing. In this installation, the hallway or office can be seen as the cave and the real world is in both cases the reality. However, the users are the philosophers in Plato's theory and have already been freed from the cave. They know that the projection is just a "shadow on the wall".

Figure 6: Realization of the image stream

2.3.4 From the Cave

From the Cave is an actual physical installation that represents Plato's Cave, made by Erical Lee. She saw that in the first year of the corona pandemic, digital devices were the only left connection for people to stay in touch with the outside world. They offered connection, information, and community [24]. She painted her view of the world that she had created during corona time on her own house walls. The installation visualizes the new ways that isolation and technology have changed our own vision of the real world and how we may about returning back to it. She only painted during nighttime and lit up the room by using the blue light emitted from digital devices, as that was her reality at that time. This artwork has a strong connection with Plato's Cave. The view of the real world was only presented by digital devices. They are the created shadows on the wall in the Allegory. The people in lockdown are the prisoners, who can't see anything besides the view presented by their digital devices. The real world in Plato's Cave is also the real world in this artwork.

Figure 7: Realization of From the Cave

2.3.5 Conclusion

There is a lot of artwork inspired by The allegory of the cave by Plato, but there are no existing interactive installations found that use this theory. The paintings are mostly used as a static and very literal representation of the cave. Although it can be in an abstract form, it does not deviate from Plato's original idea.

The movies The Matrix and The Truman Show, which can be very strongly related to the cave, have no connection with an actual cave with shadows on the wall. However, they make use of (almost) all the principles of Plato's allegory. These movies are made as entertainment for a large audience, thereby reaching a lot of people. But this is not an artwork that people can interact with. It can make people aware of the principles of Plato's cave, but they don't have to act on it.

The physical installations based on Plato's cave use Plato's allegory more as a background theory. With From the Cave, she was inspired during covid and was thinking about the perception of connections we only could make via digital devices. She later on linked this thought to Plato's cave. The image stream is not that closely related to Plato's cave. They found some agreements with the cave, partly by accident, but it was definitely not inspired by Plato.

None of these artworks include real interaction with the user. That will be the unique selling point of the installation that will be created in the project. That installation will also use Plato's Allegory as a basis but let users really interact with the system so they are more actively learning about this ethical dilemma.

3. Method and Techniques

3.1 Design method

A fittin standard design process that can best be used for this project is the Design process for CreaTe by Mader & Eggink [25]. This process is developed for Creative Technology students from the University of Twente. This model starts guides students to design new products, starting from the design questions to the evaluation of the finalized product. The model exists of three layers. This process is visualized in figure 8.
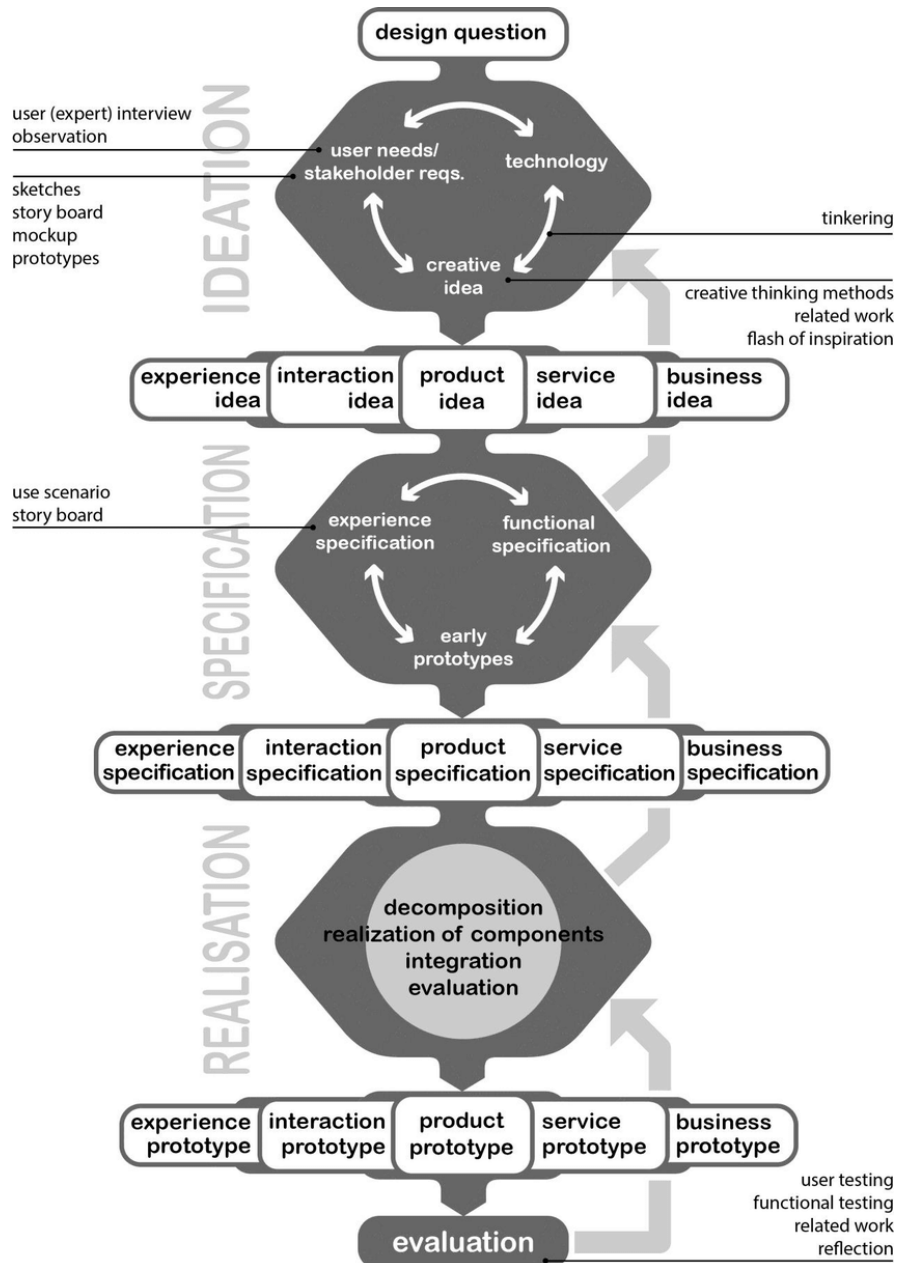
Figure 8: Design Process by Mader & Eggink

The first phase of the model from Mader & Eggink is the ideation layer. This is the starting point of the Creative Technology design process. A Creative Technology project can either start with a new technique, a client, or a creative idea. This project started with a client,

namely the Lectorate of Ethics from the Saxion, and this client had a new creative idea. After the starting point is defined, the process continues. Multiple concepts will be created based on previously set requirements. The second phase of this model is the specification. In this phase, the ideas are specified in more detail. The last phase is the evaluation phase. Here, the final product will be evaluated by using user testing and functional testing. The process is not linear. That means that it is possible to go back to previous phases if night insights or ideas have come up.

3.2 Stakeholders

Stakeholders are important to identify to create a good design for your product. Each stakeholder has in some way an interest in the project or final product. They can all have their own requirements and interests. The stakeholders can be placed in a Stakeholder Interest and Impact Table [26]. An example of such a table can be seen in the table below.

	Stakeholder	Interests	Estimated Project Impact	Estimated Priority
Primary	Owner	Achieve targets Liability (avoid at all costs) Increase sales margin	Med + High - Med +	1
	Sponsor	Successfully addresses needs of adjunct customer Appears competent among peers Provides new market to expand ventures	Low + Low - Med +	3
	Team Memebers	New product excitement Demand end-of-year bonus Retain and expand skill level Strike (if basic demands aren't met with new process)	Med + ? Med + High -	2
	Project Manager			
Secondary				

Table 1: Interest and Impact Table example

This list of stakeholders can then be implemented in an Interest Grid. This is a visual overview of the involvement of all the stakeholders. It tells you how much a certain stakeholder should be informed during the creation process. An example of such a grid can be seen below.
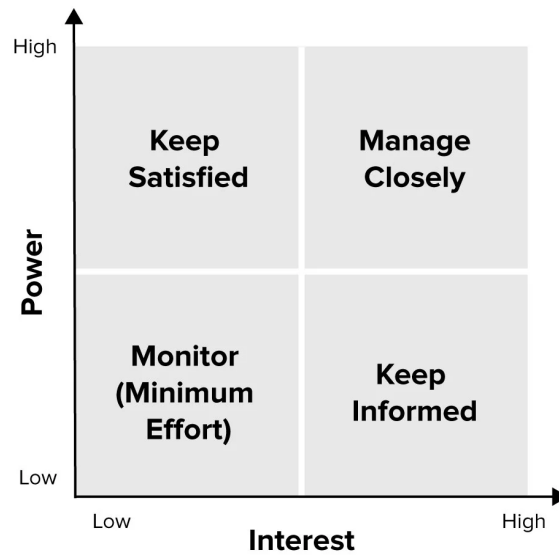
Figure 9: Interest Grid example

3.3 Identify requirements

After identifying all the stakeholders, it is important to gather more information about every stakeholder's needs and wishes. This will be done by interviewing and having physical meetings to talk about this. This will lead to a better understanding of each party that is involved. The results of these interviews and meetings are used to create a list of requirements for the product. These requirements are the basis for the ideas that are made in the ideation phase.

4. Ideation

4.1 Stakeholder analysis

The following stakeholders are identified for this project:
1. University of Twente
2. The Lectorate Ethics and Technology
3. Saxion University of Applied sciences
4. Students

These stakeholders are implemented in the Impact Table below to identify the role of each stakeholder.

Stakeholder	Interest	Impact	Priority
University of Twente	Creating a successful project	High	1
The Lectorate Ethics and Technology	Creating an Ethics Lab with interactive installations for students	High+	2
Saxion University of Applied sciences	Providing space and money for the project	Low	4
Students	Target group for the end product. A successful product can help their ethical awareness	Med+	3

Table 2: Impact Table

The stakeholders are then placed in an Interest Grid to identify their involvement. This is to keep track of updating stakeholders involved and their engagement with the project. The grid can be seen below.
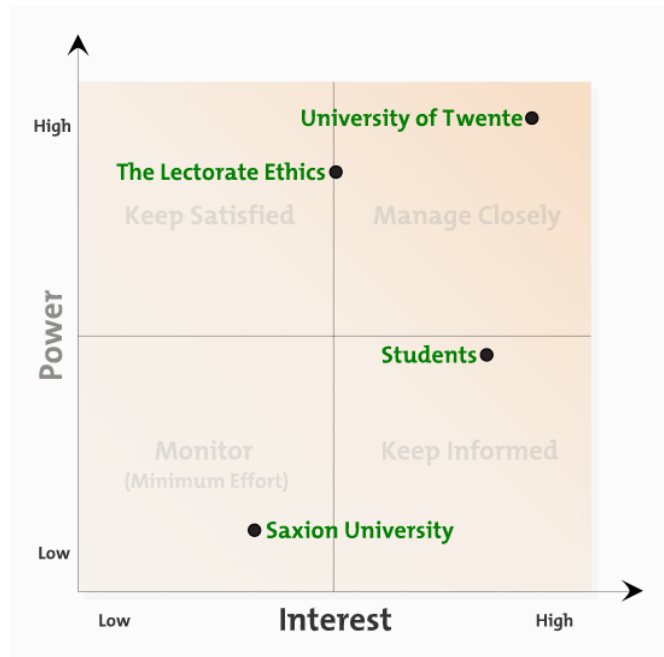
Figure 10: Interest Grid

4.2 Requirements

4.2.1 Client requirements

To gather information about the University of Twente's requirements, a meeting is scheduled every week. During this meeting, the progress of the project is discussed. There is room to ask questions to the supervisor to get insight into his personal vision. Also, the supervisor can give advice and mention other requirements that are important to him.
Once every 3 or 4 weeks, there is a scheduled meeting with members from the Lectorate. The progress of the project is shown to them and they can state all their visions and requirements. The initial concepts are also discussed during these meetings so they can give feedback and mention a preferred choice of one particular idea.

4.2.2 Target group requirements

It is important for the ideation of the final concept to get to know the target group of this installation. In this case, students are the target group. They are asked about their opinions.

4.2.2.1 Interview

To get a better insight into the opinion of our target group, interviews are conducted. During these interviews, the participant was first asked about demographics. After that, they were asked about their general vision of ethics and if they think that learning about ethics is important. Then they are asked about Plato's cave. The participants are first asked how they preserve reality and if they think they know what the truth is. After this, participants were asked if they know the Allegory, and if not, it gets explained to them. They get asked if they know any topic from today's society that can be related to this theory and thereby getting to know why it is important to think about this allegory. Lastly, the participant needed to give his opinion about the use of an interactive installation and which problem from today's world should be implemented in the system.

4.2.2.2 Setup

The interview type was conducted in a semi-structured way. The participant was informed beforehand about the nature of the interview. The participant either met live with the researcher or an online meeting was organized. Before asking any questions, the consent of the participant was recorded. Their answers were collected and written down by the researcher during the interview. These answers can be found in Appendix A. In total, five potential end users were asked about their opinion. These five participants included three University of Applied Science students and two University students. All participants were between the age of 20 till 23.

4.2.2.3 Results

The results show that all participants think that ethical awareness is important. Most say that it is most important in accepting other cultures or religions. However, some said that it is also important to know about ethics for their profession. Only half of the participants state that learning about ethics in school is important. They say that it is important to teach students some ethical knowledge to be aware of it, especially in social interaction with others. The other half states that ethics is not something that should be taught in school, instead, they say that people should learn ethics from their families or their own experiences. This is mostly motivated by a lack of interest in ethics by the participants. However, there is one person who said that schools should not be the ones to impose ethical norms on people. By doing this, he said, people do not create their own ethical values, but just predetermined values of the school. From the participants who state that teaching about ethics is important, they all say that they should start learning about it in primary school, for most social norms. That should continue in High School and College. They included that in college, also professional ethics was important. There were two people who actually have actual ethics courses in their study program. By the other participants, some ethical questions were raised during other subjects but were not handled as very important or separate subjects.

By asking them if they think they have a representative view of the world and think they know the "truth", all people agreed with this. Some participants said that they know that not all information that reaches them is true, or they might get a one-sided picture of something, but they think they can filter that out to see the truth. After that, participants were asked if they were familiar with Plato's Cave. Only one participant had heard about it and could explain it reasonably. However, she did not know what the essence of the theory was. To all participants, the allegory was then explained. Participants were asked if they could relate this theory to a problem in today's society. Some people made the connection to social media, where they are aware that not all information is true and you mostly see the "shadows on the wall" and not the actual reality. One participant made the connection with the corona pandemic, where a lot of (conspiracy)theories about the coronavirus came to light. She said that there were people who thought that they had seen the "real world" and found out that the vaccination was not good for humans. Maybe they escaped from the cave and we are just seeing the shadows. No participant came up with propaganda as a topic, so that was explained to them, how dictators only show "shadows" to their country and hide the real, less nice world. By asking the participants again after thinking about Plato's Cave, do you think what you see is the truth? Participants were a bit hesitant. Eventually, everyone still was convinced that they had a good and true picture of the world. Two participants said: if it turns out that the government and/or scientists lie to us, and the reality is actually different, that is that. I wouldn't mind. I like the world I live in right now. This is a direct link to Plato's theory, where Plato says that it is easier to stay in the cave than to explore the real world.

After the general questions about Plato's Cave, participants were asked about their opinion of an interactive installation on this topic. All but one participant chose propaganda as an up-to-date topic to connect to Plato's allegory in the installation. They also mentioned social media, but they said that people are already more aware of this phenomenon. Only one participant said that social media should be chosen, because that is most relatable to her, and she thought probably also other students. Also, all but one participant found that experiencing this problem in an interactive installation is nicer than just being told about it, like in this interview. Only one person thought just telling about it was enough. Participants mentioned virtual reality as one technique that could be used in such an installation. Real pictures, videos, or social media posts were mentioned most to include in the installation, to create a bigger impact. By asking the participants if they would visit such an interactive installation if it existed, most of them said that they would, but only if it was connected in some form to their educational program. Only one person said he would not visit such an installation.

4.2.3 Preliminary requirements

A list of requirements is created based on interviews with students (target group) and meetings with the project supervisor and client, the Lectorate. By using the MoSCoW [27] method, the technical requirements for the installation are listed. In this method, requirements are identified that the installation Must have (Mo), Should have (S), Could have (Co), and Won't have (W). The must-haves are about requirements for the system and should always be achieved. The should-haves are requirements that should be implemented during the project. They are less strict than the must-haves but still expected to be implemented in the product. The could-haves are option requirements that could be implemented if there is lots of time left at the end of the realization of the product. These are extras to the system that might be nice to add in the future otherwise. The won't haves are requirements that are not beneficial to the installation or just not feasible. The functional requirements for the system are listed below.

The installation must:
- Cost less than €500
- Interact with the user
- Fit within the assigned Ethics Lab space

The installation should:
- Have a physical appearance, not just digital
- Include a link to a problem in today's society
- Have stand-alone functionality

The installation could:
- Be foldable to save space when not used
- Have an option for single and multiplayer interaction
- Include a full explanation of the Cave by Plato beside the experience

The installation won't:
- Be portable to display at multiple locations

4.3 Preliminary concepts

4.3.1 Virtual Fake

The first concept works with VR glasses. When the user puts on the VR headset, he is situated in space. The user can walk around and explore this space. First, a picture of someone's social media account is visible somewhere in that room. In this picture, the person is happy, with a lot of friends, or showing beautiful surroundings. However, after seeing the post, the space behind the post becomes visible. The user can now see the actual surrounding where the picture was taken. The user then finds out that the person was actually not happy at all, or just felt very lonely. The person could be in tears, the surroundings could be photoshopped to make it look much better than it actually was. The real situation becomes clear to the user. This can be repeated a few times per user of the installation. Afterward, a short visual explanation is given about Plato's Cave, to make people aware of his theory.
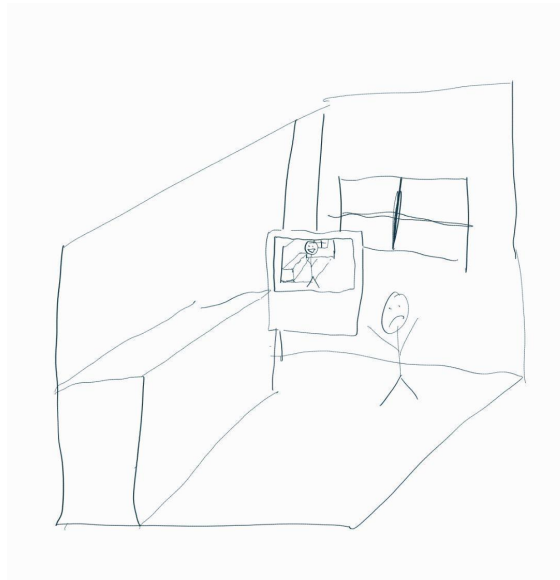
Figure 11: Virtual Fake

4.3.2 Propaganda Cave

The second concept is about projecting on a "cave", created from white sheets. From the outside, a projection is projected on the sheets. This is a silhouette of a county. People should associate the country with beautiful touristic attractions and a positive spirit. The user gets to see beautiful (real) social media pictures that are taken in that country. The user has to locate that location on the silhouette. The user can rate this place to get their view of certain touristic places. After that, the silhouette becomes visible, and not only does the object become visible, but also protest, poverty or human rights violations become viable in the picture. Showing more pictures that the user has to locate and the more of the silhouette reveals, the more negative the picture will actually be that is presented in the "cave". In the end, the user sees no shadows on the wall, but a real image where all the negative, concealed sides of the country are shown.
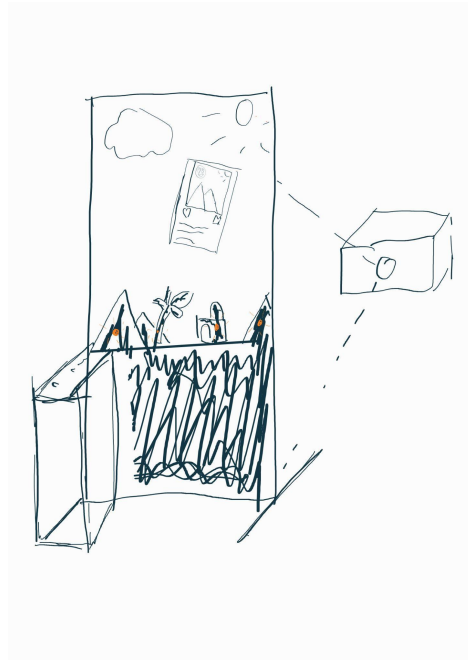
Figure 12: Propaganda Cave

4.3.3 Preferred concept

The propaganda cave is the current preferred concept. This concept was chosen because of personal motivations and feedback from the Lectorate. They want to make a strong connection with the original theory of Plato. Projecting silhouettes on cave-shaped sheets is much closer to the original allegory than using a virtual reality technique. Also, this installation has a much better physical appearance, which is preferred over just a virtual reality headset. Lastly, this concept includes propaganda as an up-to-date social dilemma. This real-world problem was overwhelmingly chosen during the interviews with the potential target group. Besides that, not only propaganda is used, but it is also highly connected to social media.

5. Specification

5.1 Design Requirements

In this chapter, the requirements from the previous chapter are used to create a final design for the interactive installation. The functionality of the preferred concept will now be converted to a complete design where all interaction and design choices should be made clear. The MoSCoW [27] method is used to define the final design of the installation.

The installation must:
- Emphasize the effect of being in a cave
- Confront the user with the effect of the Allegory of the Cave
- Frame the user into a positive view of Egypt

The installation should:
- Inform the user of the tasks the user should perform step by step
- Inform the user about the underlying Allegory of the Cave by Plato
- Confront the user with the effect of the framing, performed by the installation

The installation could:
- React to all possible outcomes of the installation (based on the influence the system had on the user)
- Have a menu with user option during the installation
- Have an appealing visual appearance

The installation won't:
- Be adjustable for up to date information within the user interface
- Include a constant feedback loop for future development

5.2 Product Design

5.2.1 Physical design

To make the concept more relatable with the original theory by Plato, the installation is shaped like a cave. This shape can be compared with the shape of a beach tent as can be seen in figure 13.

Figure 13: Beach tent

One user should be able to sit inside this tent during the experience. Therefore, the dimensions for the shape should be around 1.5mx1.5mx1.5m. This also fits in the located Ethics Lab room.
White cloths should be used to create this cave form. Images will be projected on this shape by using a beamer. That means that the white cloth cannot be too thick, because that will prevent the image from the beamer properly coming through the cloth. The beamer should have a high enough resolution to not create distorted images when looked at from a close distance. Also, the beamer should at least have an output of 3000 lumens to be bright enough to project on the cave. The image that this beamer projects on the "cave" will be horizontally mirrored to display the image correctly for the user from within the cave. The image will also be meshed around the 3d shape to create straight projections on a 3D object. The projected image will also be masked to prevent projecting an image beyond the installation. This can be done with free video mapping software like VPT8. Using a SPout renderer from the game to VPT8, the image can be projected properly.

5.2.2 Interaction Design

To register inputs from the user, four HC-SR04 Ultrasone Sensors are used. This sensor type is displayed in figure 14. Most distance sensors make use of InfraRed light to measure the time from the puls to the receiver. However, since (sun)light also emits lots of infrared light, these sensors are highly influenced by outside conditions. There are IR sensors that overcome this problem and can also accurately measure distance, however, these are much more expensive than these ultrasonic sensors. The HC-SR04 sensor can very precisely measure the distance to an object between 2cm and 4m and have some great advantages over other distance sensors. This is done by sending an ultrasonic pulse, by activating the trigger pin on the module. This ultrasonic sound is reflected by any object placed in front of it and is captured on the echo pin.

The distance to the object can be determined with the formula:
$Distance = (speed * time) / 2$, where the distance is the distance till an object in cm, speed is the speed of sound (340m/s), time is the duration of the pulse in microseconds, and is divided by two because it takes twice as long for the signal to go to the object, and reflect. If the user places their hand before the sensor, the sensor will detect this object. This detection can be used to process the inputs from the user. This technique is used to select an object in the cave by placing their hand before the object on the cave wall. A fifth sensor is used to select question options A, B, or C. This can be done by moving your hand up and down above the sensor, where a high location is selecting A, the middle is selecting B, and the low to the ground is selecting C. An input is accepted when the user holds their hand to select an option for two seconds. The full Arduino code for these sensors can be found in Appendix C.

Figure 14: HC-SR04 sensor

5.2.3 User Interface

The design should overall create an Egyptian feeling for the user, while still being in a cave. This Egyptian feeling will mostly be created by using some stereotypical characteristics of Egypt such as the desert, Pyramids, and Egyptian-style music.
The installation will start with a projected cave entrance which the user has to enter, to start the installation. An instruction text is displayed with an explanation to the user on how to start the experience.
The user will then be placed in a desert surrounding, but with all objects black, so that only the silhouettes of the objects are visible. If the user wants to select a location, the object will display a white glow on the outside of the object to highlight to the user which object they have selected.
During the answering of the questions about Egypt, the questions will be displayed on the left of the cave, also in a desert surrounding. While the user is working on the question on the left, two news articles are displayed on the right of the installation, unnoticed by the user.

After answering a question, the installation will display a screen that notifies the user if they answered the question correctly or wrong.

The final part of the installation, which is the revelation of the one-sided news that is presented to the user, is shown to the user via a video that will be displayed on the full cave, so the user is fully surrounded by the ending.

5.2.4 Audio and video design

The installation will make use of sounds to give audible instructions or information, but also to make the installation more attractive to engage with. The following audio will be used:
- Voice over
    - Installation start
    - 4 questions
- Selection
    - Hand placed
    - Hand removed
    - Object selected
- Answer
    - Good answer
    - Wrong answer

The installation start will be an explanation about what the user is seeing and what they have to do to go through the experience. The questions presented in the cave are also read by the voice-over.

After answering a question, the user is given feedback on whether they answered correctly or wrong. This is also made clear with an audible sound effect.

At the end of the installation, a video is shown to the user where the more negative truth about Egypt is shown. This video shows screenshots of real news articles and also shows real video images of Egypt. A voice-over is giving the user more information during the showing of the video and will in the end relate the experience back to the original theory by Plato.

5.3 Installation flow

The installation will start with the user entering the cave. The user can enter the cave by placing their two hands in front of them. After that, the user moves on to the next screen and sees the silhouettes of Egypt. The user gets a short explanation of what they see and what to do with the installation, and how to do it. This instruction is given by a voice-over. The user sees a social media post projected on the cave. This social media post is taken at one of the 4 hidden locations on the cave wall. When the user recognizes this location, they can hold their hand before the corresponding silhouette, and the location will be selected.

While the user is presented with the question on their left, news articles with the more bad truth are displayed on the right of the user. While this is the case, a camera will capture the user looking to the left, while the correct answer is presented on their right.

After answering the question, the user is given feedback if their answer was correct or wrong and shown a video with more information about the topic. Then the selection of a location and the answering to a question is repeated three more times.

The last questions of the installation will ask the user about their impression of Egypt. After answering this last question, the user is presented with a video that shows other, more negative sides of Egypt in contrast with the questions. The user is also confronted with the pictures taken during the installation, where the user could have seen the truth.

After this ending video, the experience is over and the installation will return to the beginning screen.
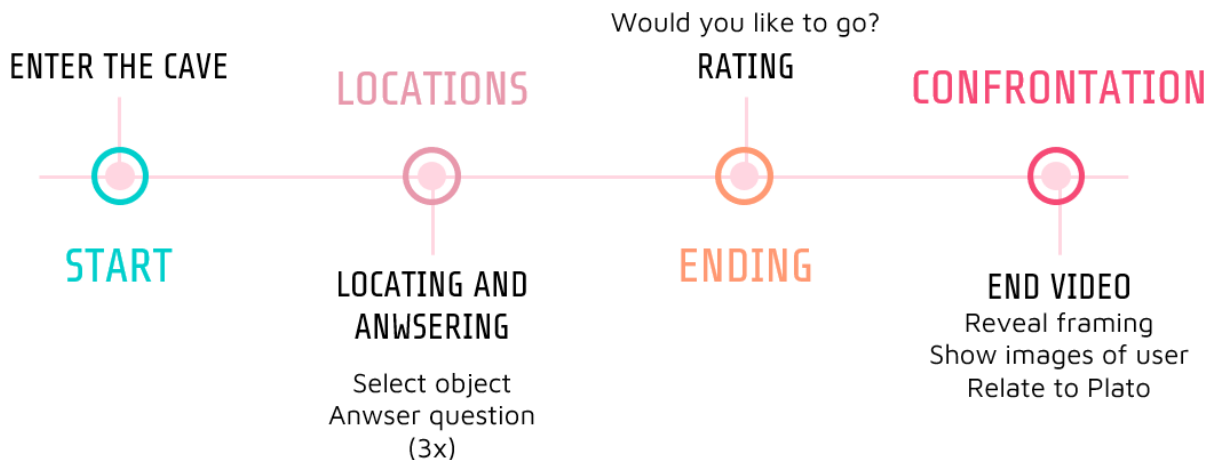
Figure 15: Installation flow

6. Realization

6.1 The cave

To create the cave, two tent sticks of both 5m are used as the base of the frame. One stick is placed vertically and the other horizontally, at a 90 degrees angle with each other. The horizontal stick is held in place by a 2m wide cloth with iron rings at the ends to place the stick in. The vertical stick is connected to the horizontal stick with a 3D-printed coupler, represented in figure 16 below.
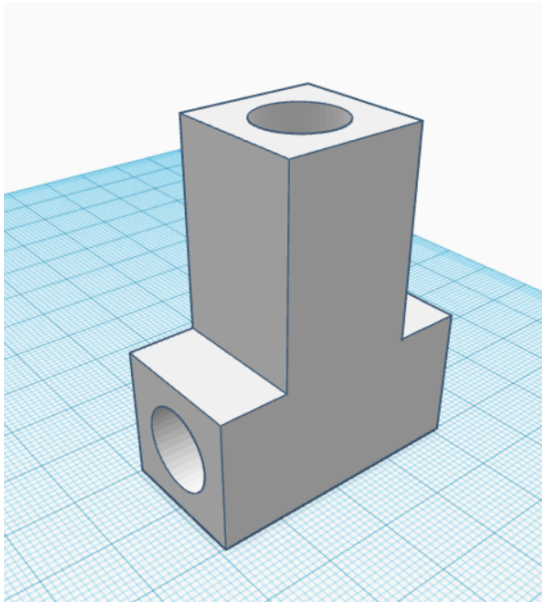
Figure 16: 3D-printed stick holder
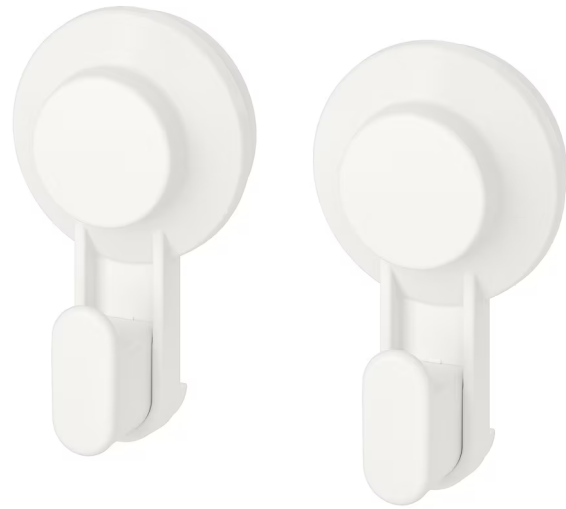
Figure 17: Two suction cups

To give the frame more strength, and to prevent it from moving, four suction cups are used to clamp the frame. The horizontal stick is clamped directly with two suction cups. The vertical stick is connected to two guy lines which are connected to two other suction cups. These clamps will counteract the force of the white cloth that covers the installation.

The white cloth is created from two flat sheets of 220x250cm. The flat sheets are connected to each other by using needles to create one big cloth of 220x500cm. However, because the installation had to move later on from Enschede to Deventer, the cloths were sewn together later on. This cloth is spread out over the installation and fastened to the tent stick by using needles to clamp the cloth around the sticks. The cloth is tightly strung by shortening the guy lines. The end result, with a projected colored image on it can be seen in the picture below.

Figure 18: Prototype with cloth

6.2 Electronics

To connect the sensors to the frame, 3D-printed sticks were made to clamp the sensors to the frame. These sticks are 15cm long to create a bit more distance between the sensor and the cloth. To be able to rotate the sensors to change their measuring height, the sensors are placed in a 3D-printed mount [28] that is rotatable to change the measuring position height. The sensor is connected with a small screw and bolt to the stick to also be able to rotate the sensor horizontally.

Figure 19: Sensor in 3D-printed mount

The four sensors are placed at the corresponding location to the location in the projected image. The fifth sensor, which should have registered the A, B, and C options during the questioning is left out. During the build, the fifth sensor would be in the exact same place as the most left sensor, so this extra sensor was not needed anymore.

Figure 20: Sensor placement in the installation

The sensor is connected to an Arduino in front of the cave via a 4-core telephone wire. There are female jumper wire connectors soldered on one side, and male jumper wire connections on the other side to easily connect the sensor to the Arduino.
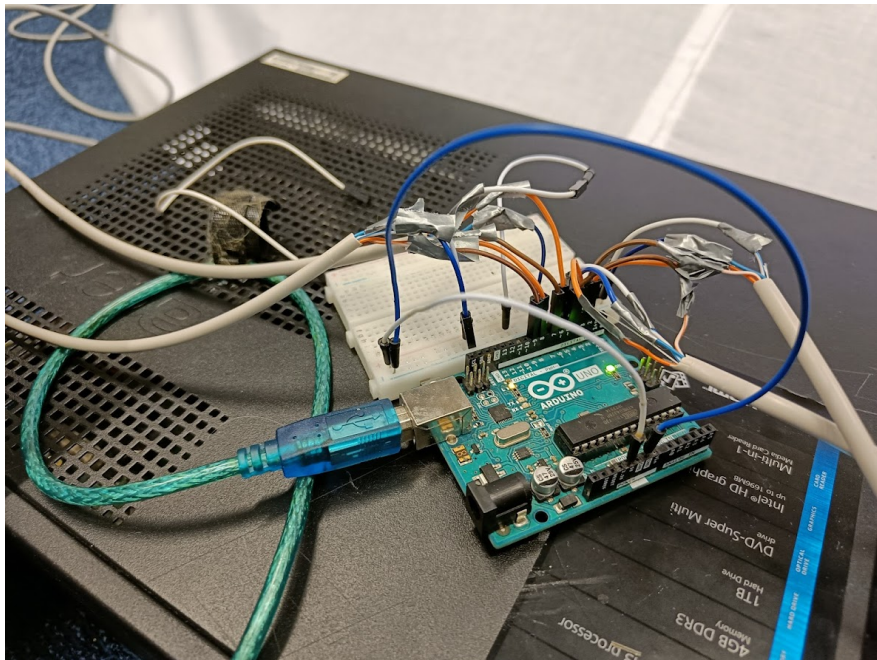
Figure 21: Arduino setup

A webcam is placed on the left side of the cave, to capture the user and the right side of the temple in one frame. The webcam is connected via an USB wire to the computer. Also, two speakers are placed in the front center of the cave to play all audio during the installation. The speakers get power via an USB connection and receive audio via a 3.5mm cable.

Figure 22: Webcam placement

Figure 23: Speaker placement

6.3 User Interface

To start the installation, the user has to "enter the cave". An image of a cave together with an instruction text is displayed as shown in figure 24 below. The screen is designed to emphasize that the user is virtually entering a cave. The fact that the installation is 180 degrees around the user will highlight this.

Figure 24: Start screen

After the user has entered the cave, the user is shown all the silhouettes from Egypt in front of them. A short instruction text is displayed to tell the user what to do at this point. However, this is only an extra reminder, because the voice-over will explain in much more detail the required actions needed by the user. The social media post that the user has to locate is displayed on the bottom, slightly right to the center. Because the full image is 180 degrees around the user, the most important information will be displayed straight in front of the user. A hand is displayed on each Egypt object. This is the location where the user should put their hand to select the object of their choice. The full scene can be seen below in figure 25.
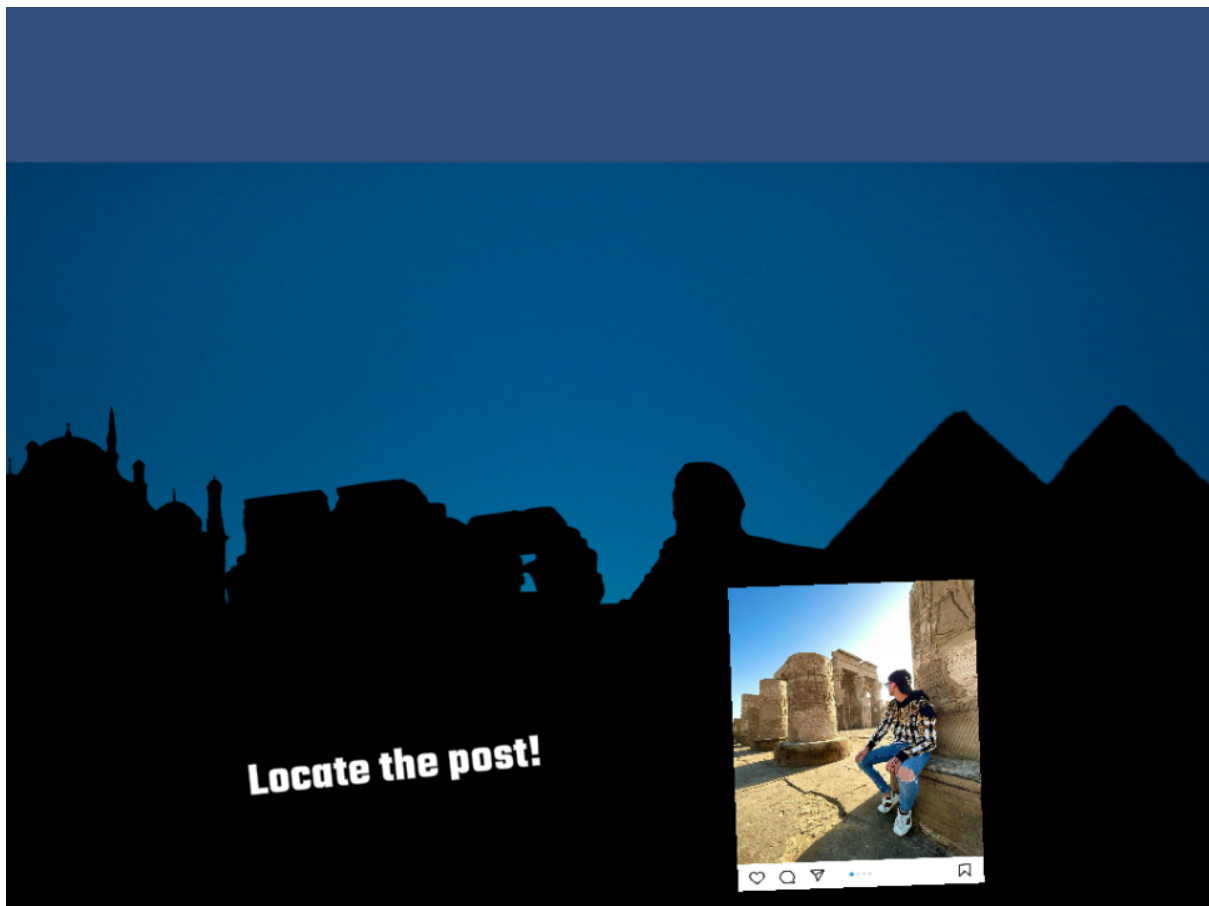
Figure 25: Locate the social media post screen

If the user places their hand on a chosen object, the object will be highlighted by adding a white glow around the object as displayed in figure 26.
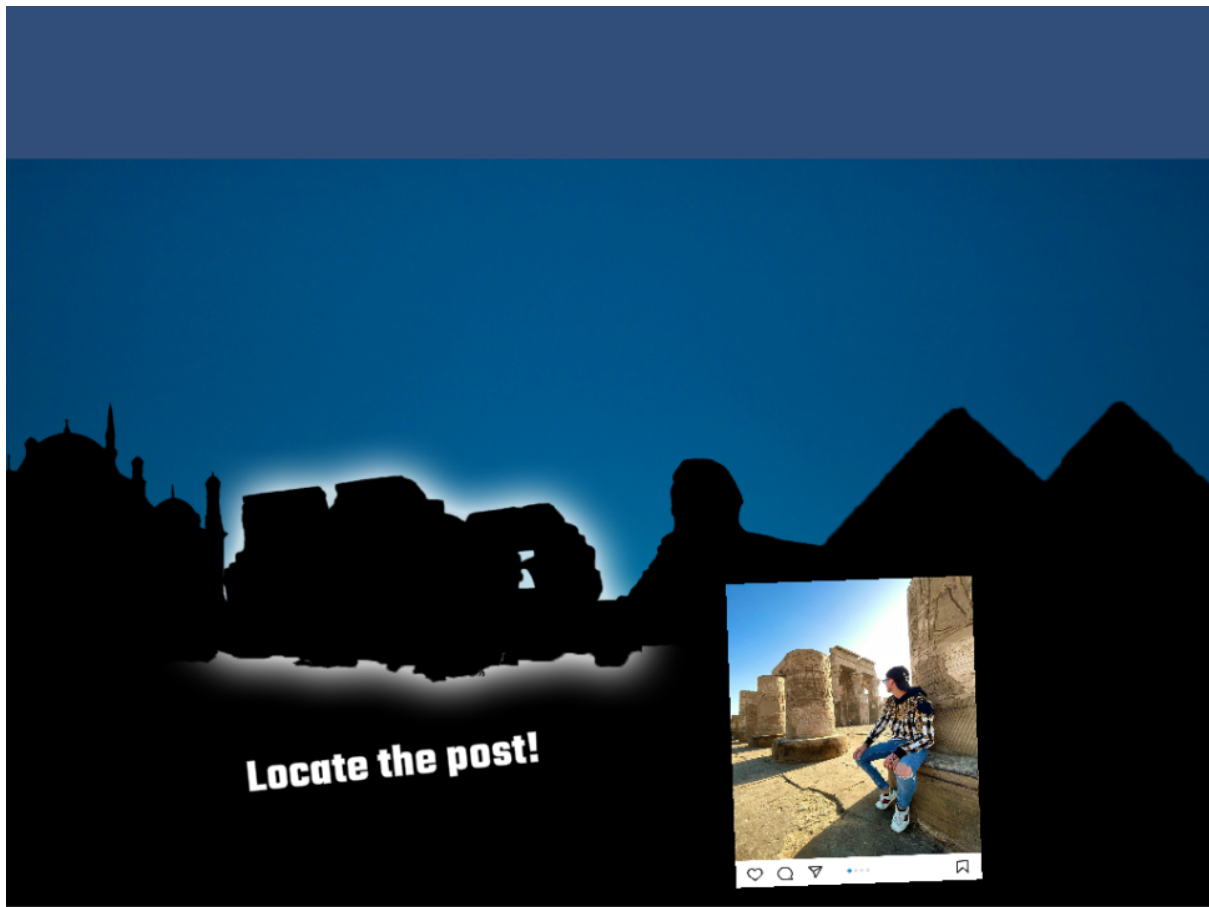
Figure 26: Highlighted object

If the user holds their hand at that object for two seconds, the object will be selected. If the user answered wrong, a message will pop up to let the user know that they choose the wrong location and should try again. If the user has located the correct object, corresponding to the post, the object will be made visible and a message informing the user that they have chosen correctly will pop up.
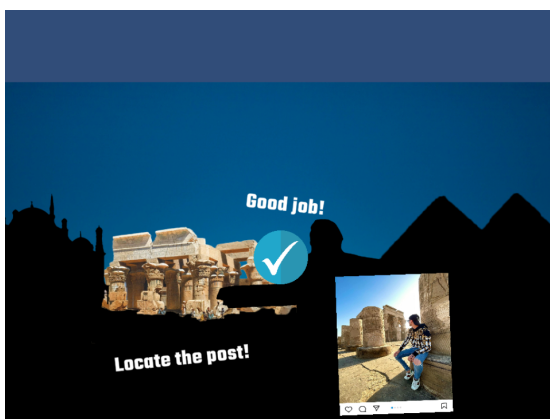
Figure 27: Good answer
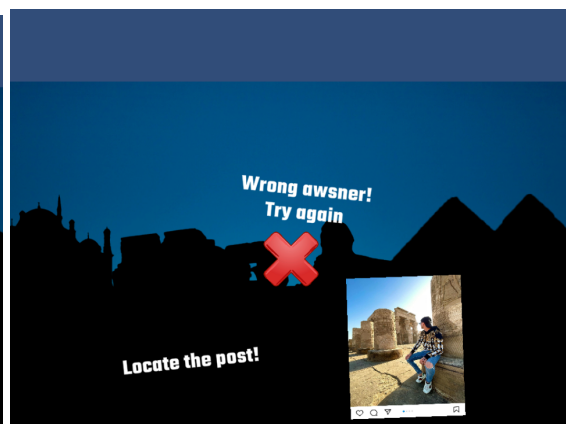
Figure 28: Wrong answer

The answering to the question is done in a desert-style setting. The question and the multiple choice options are displayed fully on the right side of the screen. A wooden-style arrow is pointing to the left to focus the user's attention on the left side of the screen.

Figure 29: Question answering screen

During the answering of the questions, other information about Egypt is shown to the right of the user. The news article's title is shown in white letters as far to the right as possible. The user will not see these texts as he will be reading on his left and will not focus any attention on his right side.

Figure 30: Facts displayed on right

After the user has answered the question, a pop-up screen will pop up to tell the user if the question was answered correctly or not.
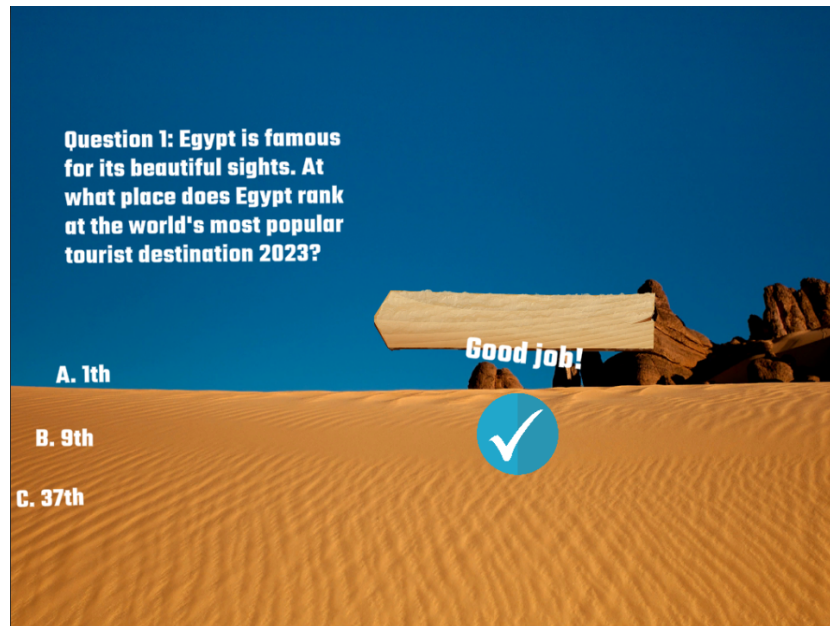
Figure 31: Question with good answer

At the end of the installation, the end video is shown to the user. This video consists of videos about Egypt in the style of the topic. Together with the voice-over, screenshots of factual news articles are used to emphasize the confirmation with the user. Also, the taken photos of the user during the questioning will be shown in this video. The top of the display is left black. This is done because the top part of the installation is too high for the user to comfortably look at. The video is shifted downwards so the viewing angle is easier for the user. That is also why the news articles are shown at the bottom of the screen.
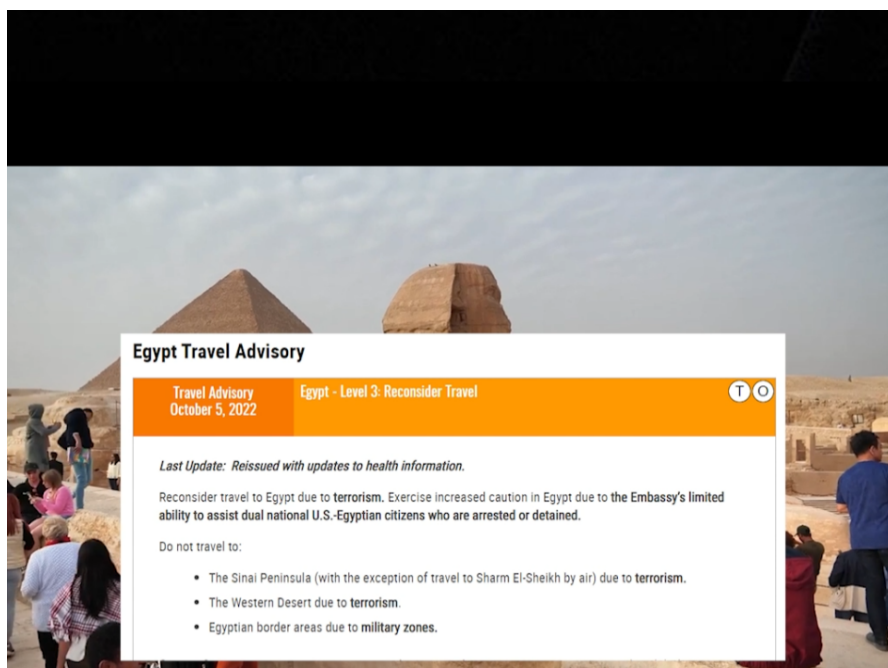
Figure 32: End video

6.4 Questioning

Facts about Egypt are presented to the user during the experience. These facts will frame the user by only showing very one-sided information. To frame the user during the experience, the following three topics are chosen:

1. Tourism
2. Feminism
3. Cash reserves

These topics cover a very broad spectrum of interests. The tourism question shows the user that lots of people like to visit Egypt. This indicates to the user that Egypt is probably also a nice country for them to visit once. Feminism is closely related to human rights for lots of people. Presenting the user with a question that shows that Egypt is improving conditions for women, will let the user think that Egypt is doing well with human rights and freedom of speech. Cash reserves are for most people highly relatable to wealth. If Egypt supposedly has lots of money, the user will probably assume that people also have good living conditions and therefore experience little poverty in Egypt.

In reality, Egypt's values on these topics are very far from our western values. The ethical problems in these topics are apparent and therefore nicely suitable to use in the installation.

For each topic, a question is created to highlight a positive fact about Egypt. In the end, each positive representation of Egypt is refuted by two negative facts about Egypt on the same topic. The positive facts about Egypt are:

1. Egypt ranks 9th among world's 17 most popular tourist destinations in 2023 [29]
2. Radwa Helmy: Egypt's first-ever female judge [30]
3. Egypt pays $2.5B in foreign debt payments within 2 months [31]

The negative facts about Egypt are:
1. Egypt is only 37th on the top 50 countries list with the most tourism [32]
2. Egyptian militants warn tourists to leave or face attack [33]
3. Egypt's government does not tolerate feminism but its own [34]
4. Egypt 'worst for women' out of 22 countries in Arab world [35]
5. Why Egypt is asking its people to eat chicken feet [36]
6. Understanding the Current Levels of Poverty in Egypt [37]

The goal of the three positive facts about Egypt is to frame the user into thinking that Egypt is actually a very nice country to visit once as a tourist. To create this frame, the user is presented with high tourism rates for 2023. The installation will also show that Egypt is progressing in its standpoint on women by starting the first female state judge ever and having lots of cash reserves.

After these three topics are presented to the user, the user will be asked: "How much would you like to Egypt now on a scale from 1 to 10?". The user will likely choose a very high number, because of the positive framing he has seen before. This is the last question presented to the user.

5.4 Prototype evaluation

5.4.1 Setup

The first prototype was tested by a 21-year-old student and friend of mine from the Saxion University of Applied Science. The participant was given no background information about the installation and was asked to step into the cave and follow the instructions presented by the installation. Afterward, an open discussion was held between the participant and the researcher to get more insight into the participant's experience. A first prototype was used to test the installation.

Figure 33: First prototype setup

5.4.2 Pilot results

This pilot was mainly focused on testing the installation for big errors and testing the clarity of the instructions. The flow of the experience was also evaluated. Already from the start of the user testing, the installation showed some serious problems. The user could not place their hands correctly to get the sensors to react to the input. With some extra help, the user could continue the experience. During the end video, the pictures taken of the user during the questioning should have been shown to the user. However, the installation failed to have taken pictures of the user and showed the wrong (test) images.

During the open discussion afterward, the user told that it was sometimes hard to understand what had to be done to interact with the installation. However, the framing worked for the user. The user had rated Egypt between an eight and ten, which indicated that the user had a very good image of Egypt after answering the questions. During the discussion afterward, the participant said that their opinion changed after seeing the end video. The user also understood how this installation was presenting the effect of fake news and could to some extent relate the experience back to the original theory by Plato.
This showed that the installation had indeed an effect on the user and was therefore fulfilling its most important requirement.
The participant stated that the experience was very short. The installation was finished in about two minutes in total. The participant stated that the installation should have a longer duration to really take in all information presented during the experience.

5.4.2 Design changes

Because of the difficulty for the user to place their hand in the correct position to select objects or answer questions, the censoring method is changed. The sensor is now directed to an exact point on the wall of the cave. To inform the user of this location to place their hand, a hand cartoon is shown on that specific location on the cave wall. If the user touches this point on the cave wall, the sensor will more consequently catch the input of the user's choice.
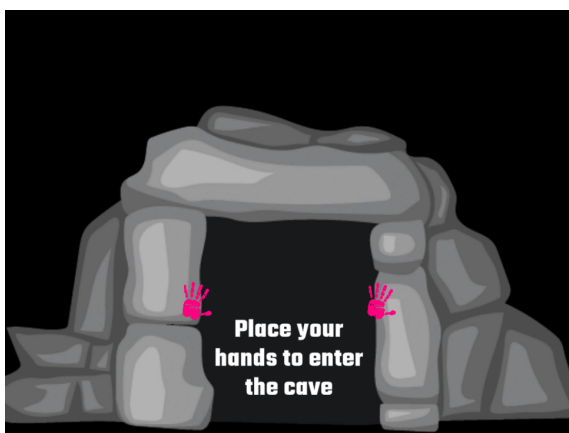
Figure 34: Start screen with hands
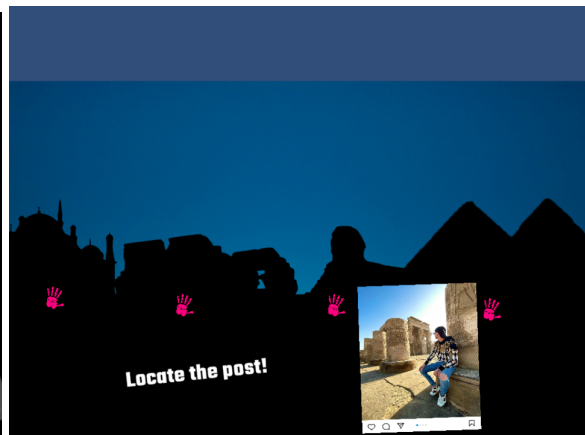
Figure 35: Locate screen with hands

To make the instructions on what the user has to do more clear, a more detailed voice-over is implemented to give more precise instructions on the needed user actions. To make the duration of the full experience longer, the user is presented with a video with extra information on the subject of the question. This creates a longer experience for the user and also provides more information to the user to create stronger positive framing of Egypt.
So now, after answering the question, the user will still be shown a similar pop-up screen to inform the user if the question was answered correctly, but will now also include a video with more elaborate information on the topic that will play in almost full screen to the user.
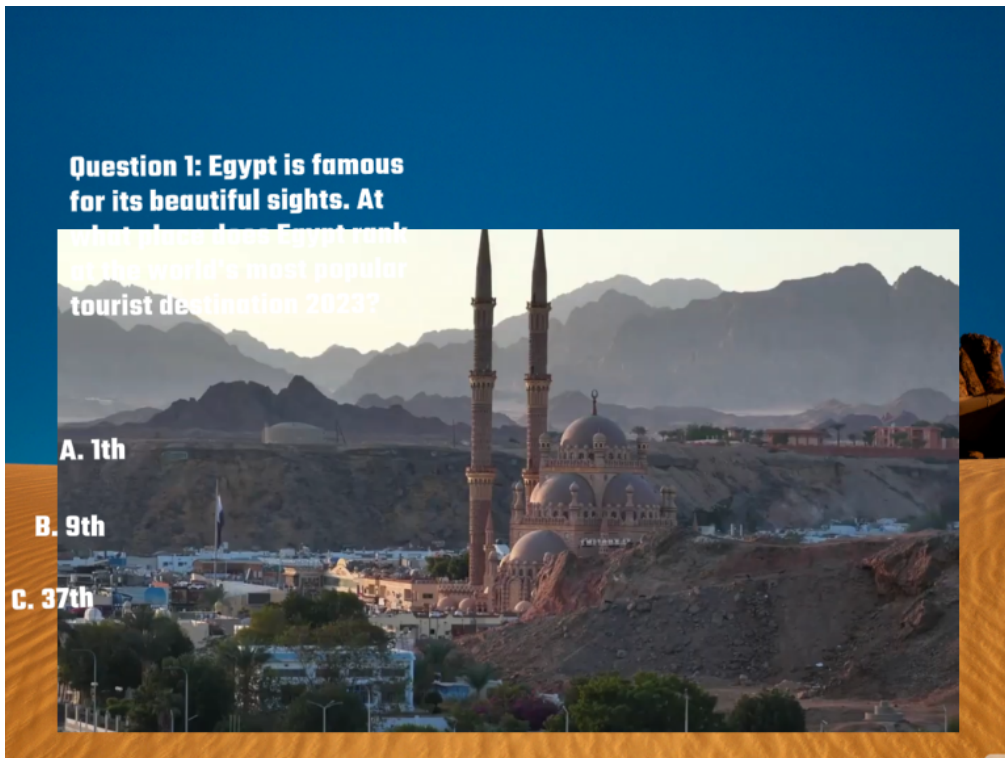
Figure 36: Question explanation video

The last questions will be changed from "How much would you like to Egypt now on a scale from 1 to 10?" to "How likely would you recommend visiting Egypt to your friends on a scale from 1 to 10?". This is because external factors can influence the first questions. For example, people can say that Egypt is too warm for them, too far away, or too expensive to go to. This is however not something that should be considered when answering this question.

Lastly, parts of the code need to be rewritten to fix the error that prevented the system from taking photos during the answering of the questions by the user. That means that the final installation flow is as follows.

~~Would you like to go?~~
How likely would you recommend Egypt as holiday destination?

ENTER THE CAVE

LOCATIONS

CONFRONTATION

START

LOCATING AND ANWSERING

Select object
Anwser question
Explanation video
(3x)

ENDING

END VIDEO
Reveal framing
Show images of user
Relate to Plato

Figure 37: Updated installation flow

7 Evaluation

7.1 Setup

The evaluation of the created installation is tested by 5 people from the target group of the installation. These people were students studying at a University or a University of Applied Science. Their age was between 18 and 24 and was a mixed group consisting of both males and females.
The participant had no information about the goal and usage of the installation beforehand. This was done deliberately so the participant would not be biased beforehand. This was also done to test if this installation could, later on, be used independently, without the need for a supervisor. They all tested the installation independently and were told to enter the installation and follow the instructions presented to them. After the test of the installation, a semi-structured interview with the user was held to get feedback from the user.

7.2 Results

The evaluation of the installation has two main goals. One is to check if the system is technically and physically good functioning. The visual appearance, technical issues, and duration of the installation are tested to create a good image of the workability of the installation. The second part of the evaluation was designed to find out if the message from the experience created by the installation was clear to the user and if it would impact the user's behavior.

7.2.1 Visual appearance

The users indicated that the visual appearance of the digital en physical parts of the installations was very nice. The fact that they were actually sitting in some form of a cave, with a 180 degrees video projected was very impressive to the user and really contributed to the experience as a whole. Users indicated that that helped them to really engage with the system and be more connected with the experience.
One remark was made about the physical appearance of the outside of the cave. The intention of the system was clear to the user, however, the system did not look very appealing from the outside with the cave entrance projected on it.

7.2.2 Technical bugs

Some technical bugs were detected during the evaluation. The webcam, used to take a picture of the user during the answering of the question, did not work every time. Sometimes, the camera only took one picture or none at all. This was a bit confusing to the user when they should have been presented with their pictures, but the screen stayed black during the end video. When this bug occurred, the user was told what should actually have happened.
A more serious problem during the evaluation was the working of the ultrasonic distance sensors. These sensors still had some trouble picking up the input from the user. This resulted in some users having some serious difficulty selecting an object or answers from the screen. This distracted the user from the actual meaning of the experience.
Besides these two bugs, no other problems were found during the evaluation.

7.2.3 Duration

The duration of the experience was about 5 minutes in total. Most users indicated that the duration of the installation was good. The majority said that if they had to choose, they would have increased the duration of the installation to get deeper into the experience. Only one participant indicated that if they really had to choose, they would have said that the duration could have been a little bit shorter. This was mostly because the flow of each round was exactly the same each time.

7.2.3 User understanding

This part of the evaluation is to get an understanding of the experience that had an impact on the user and if they understood the issue presented to them. To check if the participant was framed into thinking that Egypt was actually a pretty nice country, the answer given to the last question was noted. In the end, zero participants would have rated Egypt between 1 and 4, two participants between 5 and 7, and three participants between 8 and 10. This indicates that all users have fallen for the framing of the installation. Only after showing them the end video, did the participant's opinions change.
By questioning the user about the meaning of this installation, they all said that this installation demonstrated the clear effect of propaganda and how propaganda is used to frame people into believing that a country is doing good, while the opposite might be true. The users were also able to relate the one-sided news that was presented to them as "shadows of reality", while the full reality might be different. However, to fully relate the whole system to the original theory by Plato, some more background information about the original theory needed to be presented to them. After explaining the original theory, every participant was able to relate the experience to this theory where the questions presented to them are the shadows on the wall, the end video is the reality and the user was the prisoner.

7.2.4 Behavior change

After it was clear that the experience had influenced all participants, they were asked if they would change their behavior when the news was presented to them. However, every participant said that they would not change their behavior. The most common reason was that they chose which sources to believe and trusted that those sources would not deliberately present fake news to them. The second reason given was that it was just too difficult for the participant to figure out if the news presented to them is fake. They said that if they were framed by fake news then it is what it is, but they would not invest more energy into checking if what they believe is true, is actually true.

7.2.5 Recommendation

The participants were asked if they would recommend this experience to their friends or other fellow students. Four out of the five participants said that they would do this. However, they said that the system would probably only be interesting for people who actually have some affection for ethics. Otherwise, the user might not understand the meaning of the installation or would not care about it. The participant that stated not to recommend this installation to others was also afraid that not everyone was willing to invest time to learn about ethics in an Ethics Lab, and would therefore not ask their friends to visit this installation.

8 Conclusion

8.1 Evaluation conclusion

The created installation had indeed an impact on the user and was able to let people experience a classical ethical dilemma, in this case, the Allegory of the Cave by Plato. The participants were successfully framed into believing that Egypt was a pretty nice country. In the end, each participant was confronted with many more negative facts about Egypt, which changed their perspective of the country and created a realization that they had been framed by the installation. People were afterward aware of the effect of propaganda and had experienced that by only seeing the shadows on the wall, the reality that they created for themselves might not be the actual truth.

However, all participants stated that they would not change their behavior when presented with news articles after having this experience. This is exactly what Plato predicted in his own theory. If people have never seen something else their whole life, it is hard to accept a different reality. It costs a lot of work to adapt to a new reality, and as people stated in their answers, the users just don't want to spend more time discovering if they are affected by fake news. They will rather accept reality as is presented to them, than work hard to find out the actual truth.

8.2 Research questions conclusion

The main research question of this thesis is: How can a physical, interactive installation impact the user's awareness of ethics? To answer this question, the sub-question: How can a physical, interactive installation create the experience of an ethical dilemma? needs to be answered. To get an understanding of the relevance and need of this project, the following questions are important: 'Why is being aware of ethics important?' and 'How is the classical ethical dilemma still important in today's society?' At the end of this research, these questions can now be answered.

8.2.1 Why is being aware of ethics important?

The importance of creating an interactive installation to create better ethical awareness can be justified by the performed background research. For students to make their own independent decisions throughout their lives, knowing about ethics is needed. Otherwise, it is impossible to decide what the "good" choice is in a difficult dilemma. Ethical rules also apply in the professional world. Businesses all have a Code of Conduct on how employees should treat each other and make ethically correct decisions within the business.

Also, learning about ethics also creates better cultural awareness. It makes you understand your own culture better, but also more likely to accept other cultures that you might be unfamiliar with.

8.2.2 How is the classical ethical dilemma still important in today's society?

For the installation to be relatable to the user, it is important to know how the experience is relatable for the user. Otherwise, it will be "just" an old theory. The chosen ethical dilemma, "The Allegory of the Cave" by Plato, is still very relevant nowadays. Social media can create a very one-sided image of people. People are more likely to show their positive side and hide all the negative. Not only personal information but also fake news is well spread over the internet. It is hard for people to distinguish between true and fake news. This can lead to widespread conspiracy theories, which especially during the corona pandemic, were very popular. But the news does not always have to be fake to create a false image of something. By just showing the good and positive, and leaving out the negative, people can be framed into a very one-sided view of something. This system is highly used by corrupt and autocratic governments who use this tactic to spread their propaganda to their citizens to keep them happy and to keep themselves powerful.

8.2.3 How can a physical, interactive installation create the experience of an ethical dilemma?

The experience of an ethical dilemma can be created in a physical, interactive installation by combining elements from the original theory with relevance in today's society. Letting the user experience for himself how the old classical ethical dilemma can impact the user is a strong tool to make the user think of the classical dilemma. In the case of this project, the underlying thought of the theory is; "Can you accept a different reality when you have never seen that reality, but might be more real than yours?". This is highly relatable to the user with propaganda, where people will only see the positive facts, and never the negative, but they might be more true that the positive facts. This real-world problem is combined with the original shapes and surroundings of the original theory. The user is sitting in a cave and sees shadows on the wall in front of them. The installation can change the opinion of the user by showing very one-sided information to them. Confronting them with a strong influence on their own opinion makes the user realize that it is hard to figure out the truth if you have never seen it yourself. The user can then see for themselves how strongly this theory is still active in today's society. The user has now experienced for themselves what the thought behind the classical ethical dilemma is.

8.2.4 How can a physical, interactive installation impact the user's awareness of ethics?

The experience that the interactive installation creates for the user makes the user aware of the importance that ethical dilemmas still have on their own lives. The interactive installation will create a place for the user that they can think about ethical implications in their own field of study. Making them aware of the impact a decision can have, can make them rethink their own decisions within their study program. But not only to rethink already made decisions but also to create new ethical questions that the user otherwise would never have thought of. The experience created by the installation will impact the user and thereby leave a memory. If the user is ever to make an ethical decision, they can think back about this experience and use their improved ethical awareness to create a good decision.

8.1 Future work

At the end of this thesis, a working interactive installation was built that would create the experience of an ethical dilemma for the user. The installation is working properly now, however, a lot of elements can be improved to smoothen the experience. The sensors that register the user input still need more finetuning to better register the user's input. The camera randomly failed once in a while during the evaluations. Also, to keep this machine up-to-date, the questions and videos presented in this installation should be updated about every year or two.

The test users stated that they were influenced by the system and that indeed the very one-sided news presented to them had changed their opinion. However, this conclusion was only based on their sayings afterward. To really see if people's opinions have changed, a deeper evaluation of the installation is needed. Before people enter the installation, people should be tested on their opinion before entering, right after seeing the one-sided news, and then again after the end video. Only then can be definitely stated that the installation had an actual effect.

The same goes for the behavior change that no one said they would do. However, unconsciously, the user might adapt their behavior after the installation anyway. This could also be tested in further research where people's behavior on propaganda (or any other form of framing) is tested before and after the installation.

Appendix A: Ideation interviews

These interviews are used to create better insight into the user's needs, interests, and wishes. The raw results from the interviews can be found separately below.

A1 Interview 1

1. What is your age?
21

2. What is your educational level?
University of Applied Science

3. What is your gender?
Female

4. What is your nationality?
Dutch

5. What is your definition of ethics?
I think that it is something with problem statements with moral or ethical choices. But I cannot give an accurate definition.

6. Do you find ethics an interesting topic? (and why)
I do think that ethics is interesting. You are able to learn about different opinions and visions of other people. I think that it is interesting to understand those differences.

7. Do you think that is important to be aware of ethics? (and why)
Not really, I think I would not have a problem continuing without ethics classes. That is because I won't change my behavior after learning about ethics, so I don't need it.

8. Do you think that students should be learning about ethics?
No. Then you will learn about the teacher's ethical standpoints and that would block you from creating your own independent opinion.

   a. **If yes, from what school onwards?** *(primary, secondary, college)*
   -
   b. **If yes, from which degree onwards?** *(the lower general secondary education MAVO, Senior general secondary education HAVO, Pre-university education, VWO) (Intermediate Vocational Education MBO, Higher Vocational Education HBO, University WO)*
   -

9. Did you have an education in ethics yourself?
No, I did not.
   a. **If yes, what did you generally learn about?**

      b. **If not, will it be a study unit later on in your study program?**
         No, there is no ethics course included in my study program.
           i. **If not, would you have wanted to?**
             No, I would not, as explained before.

10. **Do you think that the world you are seeing right now, is real? (and why)**

Yes, I do think that I have a good image of what is real and what is not. I don't think that there is something else that "controls us" or influences me. So what I see is real.

11. **Are you familiar with The allegory of the cave of Plato?**

No, never heard of it
      a. **If yes, could you explain it to me in your own words?**
         -
      b. *If not, explain the allegory*

12. **Can you think of a topic in today's society where this allegory is still up-to-date?**

Something that could be related to the cave is censorship in North Korea. People over there only see the opinion of the government presented to them. Their citizens only see the good news about their country and all the bad news is left out.
      a. **If yes, do you find it important that people are aware of this topic and the question of perception of reality?**
      b. *If not, give some topics ((social)media, conspiracy theories, propaganda)*
           i. **How would you relate one of these topics to the allegory?**

Social media can create a false perception of perfection in people's lives and can lead to comparisons with one's own life. Some may believe that the media is biased and holds back information.

13. **With the allegory, and the up-to-date topics related to that in mind, do you still think that the world you are observing with your eyes is the reality?**

It's a mix of both. My understanding of the world is probably accurate, but I may not always believe what world leaders say. I choose my own sources of news and information.

14. **Do you want to learn more about this allegory?**

I think now you have told everything to me, I don't need to learn more about this theory.

    Explain the project

15. **What up-to-date topic would you find most interesting in relation to Plato's cave to experience an interactive installation?**

I find all 3 interesting, especially in light of the current events surrounding social media and conspiracy theories. Conspiracy theories are more interesting because people are becoming more aware of the effects of social media.

16. **Do you think that an interactive installation is a good way of making people aware of this old classical dilemma?**

Experiencing something would lead to a higher level of awareness and understanding. Experiences have a greater impact as you are fully immersed in the situation.

17. How would you envision such an installation?

A secluded space would be ideal for forming one's own opinions and later discussing it with others. Something with moving images (not static images) and buttons.

18. Would you visit the installation if it existed?

Yes, I would like to do that.

A2 Interview 2

1. What is your age?

23

2. What is your educational level?

University of Applied Science

3. What is your gender?

Male

4. What is your nationality?

Dutch

5. What is your definition of ethics?

I think that it is dealing with people, understanding others, and different cultures and beliefs interesting.

6. Do you find ethics an interesting topic? (and why)

I enjoy diving into these topics and discussing them with others. Especially now, it is a very important topic to dive into.

7. Do you think that is important to be aware of ethics? (and why)

To a certain extent, it is useful. The ethics of inclusivity are sometimes overemphasized. People should be able to tolerate others' opinions without hate.

8. Do you think that students should be learning about ethics?

Not as a separate subject. It should be merged with another topic (such as social studies). It should not be mandatory and should not impose beliefs on others.

    a. If yes, from what school onwards? *(primary, secondary, college)*

    b. If yes, from which degree onwards? *(the lower general secondary education MAVO, Senior general secondary education HAVO, Pre-university education, VWO) (Intermediate Vocational Education MBO, Higher Vocational Education HBO, University WO)*

    Middle school and high school, at all levels. Especially for those with lower education because they are more often insulting to others in my vision.

9. Did you have an education in ethics yourself?

We have discussed it in social studies. We mainly talk about racism and sexism. At the higher education level, we have intercultural awareness. It's a kind of ethics. Ethics does not need to be added, it may not have much sense. My opinion is fixed.

      a. If yes, what did you generally learn about?

      b. If not, will it be a study unit later on in your study program?

            i. If not, would you have wanted to?

10. Do you think that the world you are seeing right now, is real? (and why)

I do believe in what I see on news sites. I believe all different types of news channels. I do not directly believe everything that is being told on social media unless something is tweeted by a scholar. But overall, I think everything I see is accurate.

11. Are you familiar with The allegory of the cave of Plato?

No, never heard of it

      a. If yes, could you explain it to me in your own words?

        -

      b. If not, explain the allegory

12. Can you think of a topic in today's society where this allegory is still up-to-date?

For example, racism, my perspective is very different from that of a black man. I see the shadows because I have never been called out for my skin color. The same applies to sexism.

There are examples of a round earth, photos, and videos. But I support science. If what they tell us is a lie, so be it. Good argumentation is what is important to me.

      a. If yes, do you find it important that people are aware of this topic and the question of perception of reality?

      b. If not, give some topics ((social)media, conspiracy theories, propaganda)

            i. How would you relate one of these topics to the allegory?

On social media, you only see shadows. The media is a little more "real". On social media, everyone has their own opinion, and you don't know what's accurate, and everyone then draws their own conclusion. People look for the same opinion online to confirm their own standpoint.

13. With the allegory, and the up-to-date topics related to that in mind, do you still think that the world you are observing with your eyes is the reality?

No, I still think that the worldview I have is accurate as possible. If scientists lie to me, that's just how it is.

14. Do you want to learn more about this allegory?

I will think about it a little more. But superficially, because it will probably be too much for me otherwise. Many people try to impose a "truth" on you, and especially with this theory in mind, I will listen more to other "truths or experiences" of other people and perspectives.

      Explain the project

15. What up-to-date topic would you find most interesting in relation to Plato's cave to experience an interactive installation?

Propaganda seems the most interesting to me. Social media is also interesting, but many people already know a lot about it. Racism and sexism can also be taken into account (consider at what point in time news articles are presented).

16. Do you think that an interactive installation is a good way of making people aware of this old classical dilemma?

I think a kind of "simulation" would be fun and I think that applies to many people.

17. How would you envision such an installation?

Films with images are fun, and also very good recognizable for people. Animations are too abstract for people. It's nice to take something from the real world. "The Green Mile" and "The Shawshank Redemption" are good examples to look at.

18. Would you visit the installation if it existed?

I would like to come with a group of friends, not just by myself.

A3 Interview 3

1. What is your age?

21

2. What is your educational level?

University

3. What is your gender?

Male

4. What is your nationality?

Dutch

5. What is your definition of ethics?

I think that ethics is about deciding what is morally good or bad.

6. Do you find ethics an interesting topic? (and why)

I do have a sense of ethics, but I am not actively engaged with it. I do try to make moral choices, but I don't necessarily need to study them. It could be interesting to learn about some fields of study, like my own field.

7. Do you think that is important to be aware of ethics? (and why)

Yes, I think ethics is important when it comes to social communication. Without an understanding of ethics, it could lead to a decline in social communication. However, I don't need to know everything about ethics, and I don't have to deal with ethical dilemmas. Although ethics is important, it may not be the most interesting subject for me.

8. **Do you think that students should be learning about ethics?**

Ethics classes are important, but they may not be necessary for some fields like technical business management. However, it is important in fields like computer science, especially in the digital age.

    a. **If yes, from what school onwards?** *(primary, secondary, college)*
    b. **If yes, from which degree onwards?** *(the lower general secondary education MAVO, Senior general secondary education HAVO, Pre-university education, VWO) (Intermediate Vocational Education MBO, Higher Vocational Education HBO, University WO)*

        Ethical considerations should be discussed as early as elementary school, especially for people who live in small and homogeneous communities. It is important to talk about (cultural) ethics in such communities.

9. **Did you have an education in ethics yourself?**

No, I have not had any classes on ethics, but I did have a short class on ethics in data handling.

    a. **If yes, what did you generally learn about?**
    b. **If not, will it be a study unit later on in your study program?**
        In my master's program, there are some ethics courses
        i. **If not, would you have wanted to?**

10. **Do you think that the world you are seeing right now, is real? (and why)**

I see everything as real, but just because I see it as real, it doesn't mean it is necessarily true. There are certainly bots on social media and a lot of news is generated automatically.

11. **Are you familiar with The allegory of the cave of Plato?**

No, I don't think so.

    a. **If yes, could you explain it to me in your own words?**
        -
    b. *If not, explain the allegory*

12. **Can you think of a topic in today's society where this allegory is still up-to-date?**

I think of the people in Ruinerwolde who lived without seeing daylight and considered their basement to be the real world. The same applies to religious people who believe in God and believe that is the full truth.

This theory is also apparent in small communities where there are fewer opportunities to interact with people from different backgrounds. People can have a skewed view of these outsiders and treat them differently.

    a. **If yes, do you find it important that people are aware of this topic and the question of perception of reality?**
    b. *If not, give some topics ((social)media, conspiracy theories, propaganda)*
        i. **How would you relate one of these topics to the allegory?**

Social media algorithms can also contribute to stimulating racism
.

13. **With the allegory, and the up-to-date topics related to that in mind, do you still think that the world you are observing with your eyes is the reality?**

(Thinking for a bit…) I want to say yes, but I think I might miss certain things. Some news sources are clearly biased. I think so, but that's from my own "Western" perspective. I can understand general ideas, but I can't imagine the experiences of people in different parts of the world. My worldview is not very broad.

14. Do you want to learn more about this allegory?
Yes, I find it an interesting topic.

Explain the project

15. What up-to-date topic would you find most interesting in relation to Plato's cave to experience an interactive installation?
I think you should not religion as the subject for the installation. I think propaganda is the best option.

16. Do you think that an interactive installation is a good way of making people aware of this old classical dilemma?
I prefer an explanation to an interactive experience. I don't see the value in discussing the topic after the explanation.

17. How would you envision such an installation?
Virtual reality could be a good technique. It would allow people to experience life in a virtual world.

18. Would you visit the installation if it existed?
No, I wouldn't go to a virtual reality experience about this topic.

A4 Interview 4

1. What is your age?
21

2. What is your educational level?
University of Applied Science

3. What is your gender?
Female

4. What is your nationality?
Dutch

5. What is your definition of ethics?
Ethics is what makes us human and prevents people from crossing each other's boundaries.

6. Do you find ethics an interesting topic? (and why)
Yes. This is so that nobody gets hurt and to prevent people from feeling uncomfortable.

7. Do you think that is important to be aware of ethics? (and why)

Yes, I think ethics is important when it comes to social communication. Without an understanding of ethics, it could lead to a decline in social communication. However, I don't need to know everything about ethics, and I don't have to deal with ethical dilemmas. Although ethics is important, it may not be the most interesting subject for me.

8. Do you think that students should be learning about ethics?

I think it's good to receive education about ethics. You can also learn ethics from your environment, but in school, everyone should be made aware at least once.

    a. If yes, from what school onwards? *(primary, secondary, college)*
    I think ethics education should start at the end of elementary school. Children at a young age should have some basic understanding of ethics. If you start young, children can still be shaped by it. Later on, it might not have as much impact.

    b. If yes, from which degree onwards? *(the lower general secondary education MAVO, Senior general secondary education HAVO, Pre-university education, VWO) (Intermediate Vocational Education MBO, Higher Vocational Education HBO, University WO)*
    Ethics education should be taught at all levels.

9. Did you have an education in ethics yourself?

I have received some education on ethics, including lessons on conducting research and ethical dilemmas related to it. It was about studies that had interesting outcomes, but the research techniques used were not responsible. I did learn in courses that it is possible to find a middle ground between cultures and that children can learn to accept each other.

    a. If yes, what did you generally learn about?
    b. If not, will it be a study unit later on in your study program?
        i. If not, would you have wanted to?

10. Do you think that the world you are seeing right now, is real? (and why)

Yes, I think I have a reasonably clear picture of ethics from my own perspective.

11. Are you familiar with The allegory of the cave of Plato?

I am somewhat familiar with the allegory of the cave.

    a. If yes, could you explain it to me in your own words?
    People are trapped in a cave, shadows are seen on the wall, and that is their truth. Someone escapes and sees the real world.

    b. If not, explain the allegory

12. Can you think of a topic in today's society where this allegory is still up-to-date?

With the COVID-19 pandemic, there were many different ways of looking at the situation. Everyone had a different opinion, partly based on science and partly on other "truths".

    a. If yes, do you find it important that people are aware of this topic and the question of perception of reality?

    b. If not, give some topics ((social)media, conspiracy theories, propaganda)

> **i. How would you relate one of these topics to the allegory?**

For example, Instagram, where you see many photos of women that young girls look at and become insecure. Or people who only show beautiful pictures of their life.

13. With the allegory, and the up-to-date topics related to that in mind, do you still think that the world you are observing with your eyes is the reality?

To some extent, yes, but I am aware that it might not be real. I can imagine that things might look different. When it comes to "alternative media," I wouldn't say that it is completely false, but I would want to hear more about it before I fully believe it. However, I would tend to believe big news organizations like the NOS right away. For example, during a war, the image probably isn't completely objective.

14. Do you want to learn more about this allegory?

I find it an interesting topic to think about and talk about.

Explain the project

15. What up-to-date topic would you find most interesting in relation to Plato's cave to experience an interactive installation?

Definitely not COVID-19. Social media only shows one-sided perspectives, but many people already know about this. Propaganda is probably the most interesting.

16. Do you think that an interactive installation is a good way of making people aware of this old classical dilemma?

I would choose the installation myself. That would probably make a bigger impression on me than just a theory.

17. How would you envision such an installation?

I was thinking of using some kind of video for this. This is to experience something through images and sound and to see how something can be different from your own perspective.

18. Would you visit the installation if it existed?

I would definitely like to do that and find it enjoyable.

A5 interview 5

1. What is your age?

21

2. What is your educational level?

University of Applied Science

3. What is your gender?

Female

4. What is your nationality?

Dutch

5. What is your definition of ethics?
Ethics is making moral decisions. Decisions on how you want to be treated and what values you consider important.

6. Do you find ethics an interesting topic? (and why)
It depends on the context. Ethics in healthcare, my field of expertise, I find interesting. Other ethics are less interesting for me to know about. I find moral ethics more and more interesting.

7. Do you think that is important to be aware of ethics? (and why)
I think the principle of ethics is important, in how you treat people. But whether or not you should really need to learn about it, I'm not sure.

8. Do you think that students should be learning about ethics?
Yes, I do.

      a. If yes, from what school onwards? *(primary, secondary, college)*
      Start in primary school and gradually expand. For example, talk about ethics in secondary school for one year and again in university.

      b. If yes, from which degree onwards? *(the lower general secondary education MAVO, Senior general secondary education HAVO, Pre-university education, VWO) (Intermediate Vocational Education MBO, Higher Vocational Education HBO, University WO)*
      On all levels. Everyone should accept each other beliefs.

9. Did you have an education in ethics yourself?
Yes.

      a. If yes, what did you generally learn about?
      We called it moral judgment. We learned about making choices between sick patients (sick old woman vs. child) and also about different cultures and how to deal with them. We also often treated moral dilemmas from practice.

      b. If not, will it be a study unit later on in your study program?
         i. If not, would you have wanted to?

10. Do you think that the world you are seeing right now, is real? (and why)
No, I don't think so. That's my world with my own choices and values. For example, I know very little about other cultures and beliefs. When I had a foreign girl in class, I had to get used to her different culture and family relationship. So if you look at yourself, you can quickly get stuck in your own bubble.

11. Are you familiar with The allegory of the cave of Plato?
I have heard of it, but I don't know it.
      a. If yes, could you explain it to me in your own words?
      b. If not, explain the allegory
12. Can you think of a topic in today's society where this allegory is still up-to-date?

For example, I think cultural background has nothing to do with crime. In my own small village, some people will call me crazy for saying this. If you look today at people growing up with social media and you only see a one-sided story, you will naturally believe in it and experience it as normal.

      a. **If yes, do you find it important that people are aware of this topic and the question of perception of reality?**

      b. *If not, give some topics ((social)media, conspiracy theories, propaganda)*

          i. **How would you relate one of these topics to the allegory?**

13. **With the allegory, and the up-to-date topics related to that in mind, do you still think that the world you are observing with your eyes is the reality?**

I think only positive aspects of people's lives are shown. I then see a different image of reality. Especially on social media, if I see news presented to me, I could believe that there is some truth in it, but it depends on the subject. I wouldn't assume it's true. I will first research more about it. However, I would assume the news to be true from NOS. I think my opinions are in line with the majority.

14. **Do you want to learn more about this allegory?**

I find it an interesting topic to think about, especially when this theory would be offered by my school.

Explain the project

15. **What up-to-date topic would you find most interesting in relation to Plato's cave to experience an interactive installation?**

I am very inclined toward social media because my age group is mostly concerned with it. Also because seniors are more into it. This plays a big role now.

16. **Do you think that an interactive installation is a good way of making people aware of this old classical dilemma?**

I think letting people experience it makes more of an impact. Telling people often results in them thinking "it will be okay." An installation will have a much greater impact.

17. **How would you envision such an installation?**

When I think of social media, I immediately think of influencers. They only show you that everything is perfect. Then I would think of a projection that you walk through, starting with the influencer's view on social media, and gradually getting deeper into who he is and what the reality is.

18. **Would you visit the installation if it existed?**

I would visit the installation when I'm walking by. But I would not travel to Saxion only for this installation.

Appendix B: Evaluations

In this appendix, the raw interview results are collected from the evaluation of the created interactive installation. Each interview, held after letting the participant try the installation, can separately be found below.

B1 Evaluation 1

    1. What is your age?
24

    2. What is your educational level?
University of Applied Science

    3. What is your gender?
Male

    4. What is your nationality?
Dutch

    1. What did you think of the visual appearance of the interactive installation?
The experience itself was visually very nice. However, the outside view of the installation was not great. It was very clear what it should represent, but not very appealing. It would be more beautiful if the installation had a solid color before entering.

    2. Did you discover any bugs in the system?
Yes. The sensors sometimes had difficulty censoring my inputs. Also, there were no pictures shown of me at the end of the installation.

    3. What did you think of the duration of the experience?
The length of the installation was good. It was long enough to not feel rushed but also not too long, so you would lose your attention to the experience. If I had to choose, I would make the experience a little bit longer.

    4. Did you understand what the meaning of this installation is?
Yes, I did. I did not know that much about Egypt. I understood that I was first shown only positive facts about Egypt to make me believe Egypt was actually doing pretty well. However, in the end, I got that that was not the full truth. I would conclude from this experience that you should do better research before believing something.

    5. Do you now relate the installation to the original theory of Plato?
In this installation, I was the prisoner in the cave. Egypt is only showing shadows on the wall, and the video at the end is showing the real world.

6. How, if any, did the experience change your perception in any form?

I now know a lot more information about Egypt. However, if I had more background knowledge beforehand, it would not have worked.

7. Will this experience change your behavior when presented with news in the media and/or social media?

I find that hard to say. I don't think that I'm very easy to be influenced. Therefore, I will not change my behavior when presented with news.

7.5 You said that this installation changed your perception of Egypt by only showing the positive news facts. That proves that you can be influenced, right?

Well, yeah I was influenced at first. But that was also corrected again later on. And I don't think this will happen in the real world to me.

8. Can you think of any reason why this experience can help you in your own study?

I'm studying civil engineering. I think it can be related to environmental questions. Where people don't see the impact infrastructure can have on our ecosystem. Because people don't see this, it is not always taken into account.

9. Is there something you would add to this installation?

There were more possible topics you could have picked to discuss Egypt. For example, racism in Egypt could be interesting.

10. Are there any items that can be removed from the installation?

I did not really get why I had to locate the social media posts in the cave. So that could have been left out.

11. Would you recommend this experience to fellow students (or others)?

Yes, it would be nice for some people. However, this installation should not influence people. The installation should have a neutral standpoint. Maybe I'm still (negatively) framed by the installation…

B2 Evaluation 2

1. What is your age?

21

2. What is your educational level?

University of Applied Science

3. What is your gender?

Female

4. What is your nationality?

Dutch

1. What did you think of the visual appearance of the interactive installation?

The visual experience from within the cave was very nice. Also, seeing this big dome from the outside is really intriguing.

2. Did you discover any bugs in the system?

Yes. The sensors were not always responding properly, but that is probably my mistake. And in the end, the wrong pictures (from during the questioning) were shown to me.

3. What did you think of the duration of the experience?

The length of the installation was fine. It could have been a little longer, it was a bit short.

4. Did you understand what the meaning of this installation is?

Yes, I did. Because of propaganda, your opinion can easily be framed. That is because you only see the positive facts. However, there is also a different side to see. In fact, Egypt is pretty shitty, but you only got shown the positive aspects at first.

5. Do you now relate the installation to the original theory of Plato?

Yes, that is about people in a cave. The questions asked in the installation are about the shadows on the wall. The answers on your right, in combination with the end video, are the reality. I was the prisoner in the cave.

6. How, if any, did the experience change your perception in any form?

Egypt is not that great at all. I did not know anything about the poverty, woman rights or corruption over there.

7. Will this experience change your behavior when presented with news in the media and/or social media?

I think I actually can be influenced by the news presented to me. However, I will not dig into every news article presented to me if I think the source is trustworthy. I will not change that.

8. Can you think of any reason why this experience can help you in your own study?

I'm studying physiotherapy. I cannot really create a good connection. However, there are treatments where people take medicine, like a painkiller, to get rid of the problem. However, we physiotherapists know that painkillers only work temporarily, and do not fix the original issue. However, some medications will make you think that they can overcome your problem. The medication is only showing its positive effect, but that is only for the short term.

9. Is there something you would add to this installation?

Not really. Maybe you could have made it a bit more clear what actually was the correct answer after each question.

10. Are there any items that can be removed from the installation?

No

11. Would you recommend this experience to fellow students (or others)?

Yes, I think this installation would be nice for people to experience once. However, I don't think that everyone will learn from this experience.

B3 Evaluation 3

1. What is your age?

18

2. What is your educational level?

University

3. What is your gender?

Female

4. What is your nationality?

Dutch

1. What did you think of the visual appearance of the interactive installation?

I thought that the outside appearance of the installation looked very interesting. I was very curious about what to do with it. Also, the animations and images shown within the installation were very nice.

2. Did you discover any bugs in the system?

Not really, only sometimes, the sensors did not work properly

3. What did you think of the duration of the experience?

The duration of the experience was right. If I had to make a choice, I would make it a little shorter.

4. Did you understand what the meaning of this installation is?

Yes. When the installation showed the end video and started telling me that all information was presented from Egyptian newspapers, I knew that I was being framed. Also, I got that this was demonstrating Plato's cave with shadows on the wall. That makes you think about what is reality.

5. Do you now relate the installation to the original theory of Plato?

I was inside the cave, looking at shadows on the wall, which presented me with information that I assumed was true. However, this was not the full truth. De questions were the shadows on the wall by Plato. The video at the end was the reality and I was the "puppet" in the cave.

6. How, if any, did the experience change your perception in any form?

Egypt is framing its own citizens with very one-sided news to make them believe everything is going okay.

7. Will this experience change your behavior when presented with news in the media and/or social media?

I would not be thinking about it more than I was before. Normally, I'm not really thinking about this, only when something is clearly very subjective. I will not change that after this experience.

8. Can you think of any reason why this experience can help you in your own study?

I'm studying Mathematics. I cannot relate that to Plato's theory.

9. Is there something you would add to this installation?

No, everything was very coherent

10. Are there any items that can be removed from the installation?

No, I don't think so

11. Would you recommend this experience to fellow students (or others)?

If I know someone who is interested in these kinds of things, I would definitely recommend this installation.

B4 Evaluation 4

1. What is your age?

21

2. What is your educational level?

University of Applied Science

3. What is your gender?

Female

4. What is your nationality?

Dutch

1. What did you think of the visual appearance of the interactive installation?

It looked very interesting. I didn't have a clue what it was about, but I thought it was exciting to enter the installation. Also, the animations presented during the experience were very nice.

2. Did you discover any bugs in the system?

I had some trouble selecting certain objects.

3. What did you think of the duration of the experience?

The duration of the experience was right. If you would make it longer, it might get boring. But when you would shorten it, then it might be too short to really get into the experience.

4. Did you understand what the meaning of this installation is?

Yes. The installation was showing me that I should not always trust the news presented to me. It might give a very wrong impression of reality. The end video really opened my eyes to see that I totally believed that Egypt was doing well.

5. Do you now relate the installation to the original theory of Plato?

Yes, I understood that the questions that I needed to answer were the shadows on the wall. The video shown in the end was the real world and I was a prisoner in the cave.

6. How, if any, did the experience change your perception in any form?

I did not know that Egypt was doing so badly at the moment. Also, it was strange to see how the questions had influenced my perception.

7. Will this experience change your behavior when presented with news in the media and/or social media?

No, it won't. I'm mostly looking at the NOS and I trust that the information that they present to me is good. I don't want to put more energy to check if everything that is presented to me is actually true. If they are lying to me, then I will just accept that.

8. Can you think of any reason why this experience can help you in your own study?

I'm studying Mathematics. I cannot relate that to Plato's theory.

9. Is there something you would add to this installation?

No, I cannot think of something

10. Are there any items that can be removed from the installation?

No, you should not remove anything from the installation. Then it will be too short.

11. Would you recommend this experience to fellow students (or others)?

Yeah I thought it was really cool and impressive and would definitely recommend this to other people.

Appendix C: Arduino code

```
#include <movingAvg.h>

// defines pins numbers
const int sensorCount = 4;
const int trigPin[sensorCount + 1] = {2, 4, 6, 8, 10};
const int echoPin[sensorCount + 1] = {3, 5, 7, 9, 12};

// defines variables
long duration;
int distance[sensorCount];
int measureHeight[sensorCount] = {60, 80, 100, 70};
int questionHeight[3] = {20, 40, 60};
int questionRange = 8;
int range = 15;
int minrange = 40;
bool sensed = false;
bool waitForState = false;
long startCount = 0;
long gameStartCount = 0;
int avgCount = 5;
int currentActive;
int currentActiveQuestion;
int state = 0;
int errorCounter = 0;

//Defining moving averages
movingAvg sensor1(avgCount);
movingAvg sensor2(avgCount);
movingAvg sensor3(avgCount);
movingAvg sensor4(avgCount);
movingAvg sensor5(avgCount);
movingAvg avgDistance[sensorCount + 1] = {sensor1, sensor2, sensor3, sensor4,
sensor5};

void setup() {
  //Set all trigger pins as output and all echo pins as input
  for (int i = 0; i < sensorCount + 1; i++) {
    pinMode(trigPin[i], OUTPUT);
    pinMode(echoPin[i], INPUT);
  }

  //Start averages
```

```
  for (int i = 0; i < sensorCount + 1; i++) {
    avgDistance[i].begin();
  }

  // Start the serial communication
  Serial.begin(115200);
}
void loop() {

  //Check for input in the Serial monitor (from Unity)
  while (Serial.available() > 0) {
    state = Serial.readString().toInt();
    waitForState = false;
  }

  if (!waitForState) {
    //start screen
    if (state == 0) {
      readDistance(1);
      readDistance(2);
      delay(5);
      printStart();
    }

    //Egypt scene
    if (state == 1) {
      //  Read all sensors
      for (int i = 0; i < sensorCount; i++) {
        readDistance(i);
      }
      delay(5);

      //Print data after startup
      if (avgDistance[1].getCount() >= avgCount) {
        printTriggers();
      }
    }

    //Question Scene
    else if (state == 2) {
      readDistance(0);
      delay(5);
      //Print data after startup
      if (avgDistance[0].getCount() >= avgCount) {
        printDistance();
      }
    }
```

```
  }
}

//Get distance form sensors
void readDistance(int sensor) {
  //Read and write sensor data
  digitalWrite(trigPin[sensor], LOW);
  delayMicroseconds(2);
  digitalWrite(trigPin[sensor], HIGH);
  delayMicroseconds(10);
  digitalWrite(trigPin[sensor], LOW);
  duration = pulseIn(echoPin[sensor], HIGH);

//Calculate distance
  distance[sensor] = duration * 0.034 / 2;

  // Discard if faulty reading
  if (duration * 0.034 / 2 >= 300) {
    distance[sensor] = 300;
  }
  avgDistance[sensor].reading(distance[sensor]);
};

//Print values for start screen
void printStart() {
  bool startGame = true;
  for (int i = 1; i < 3; i++) {
    if (!(avgDistance[i].getAvg() >= measureHeight[i] - minrange  && avgDistance[i].getAvg()
<= measureHeight[i] + range)) {
      if (sensed) {
        Serial.println(0);
      }
      startGame = false;
      sensed = false;
      gameStartCount = millis();
    }
  }

  if (startGame && !sensed) {
    sensed = true;
    Serial.println(1);
  }

  if (startGame && millis() >= gameStartCount + 2000) {
    sensed = false;
    Serial.println(1);
    waitForState = true;
```

```
  }



}

//Print values during object locating
void printTriggers() {
  for (int i = 0; i < sensorCount; i++) {

    if (currentActive != 0) {
      i = currentActive - 1;
    }
    if (avgDistance[i].getAvg() >= measureHeight[i] - minrange && avgDistance[i].getAvg()
<= measureHeight[i] + range) {
      if (!sensed) {
        sensed = true;
        startCount = millis();
        currentActive = i + 1;
        Serial.println(i + 1);
      } else {
        if (millis() >= startCount + 2000) {
          Serial.println(i + 1);
          currentActive = 0;
          sensed = false;
          delay(2400);
        }
        break;
      }
    } else {
      if (sensed) {
        sensed = false;
        currentActive = 0;
        Serial.println(0);
      }
    }
  }
}

//Print values during question answering
void printDistance() {
  for (int i = 0; i < 3; i++) {

    if (currentActiveQuestion != 0) {
      i = currentActiveQuestion - 1;
    }
```

```
    if (avgDistance[0].getAvg() >= questionHeight[i] - questionRange &&
avgDistance[0].getAvg() <= questionHeight[i] + questionRange) {
      if (!sensed) {
        errorCounter++;
        currentActiveQuestion = 1 + i;
        if (errorCounter >= 50) {
          sensed = true;
          startCount = millis();
          Serial.println(i + 11);
        }
      } else if (sensed) {
        if (millis() >= startCount + 2000) {
          waitForState = true;
          Serial.println(i + 11);
          currentActiveQuestion = 0;
          sensed = false;
          delay(2000);
        }
        break;
      }
    } else {
      if (sensed) {
        sensed = false;
        currentActiveQuestion = 0;
        Serial.println(10);
      }
      errorCounter = 0;
      sensed = false;
      currentActiveQuestion = 0;
    }
  }
}
```

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