

**THE GLASGOW
SCHOOL OF ART**

Improving Online Learning for Middle School Students

MSc Major Project Design Process Journal

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Background

Discover - Define - Develop - Deliver

Online Learning

Online learning(also called as e-learning, blended learning, online education) is a term that was first used in 1995 when the web-based system WebCT was developed as the first Learning Management System (LMS). In that context, online learning was about using the LMS or uploading text and pdfs online(Singh& Thurman, 2019). Online education is used in several fields, such as schooling and vocational training.



Image from: <https://www.eslgi.com/sites/all/themes/esl/assets/img/why.png>

This project focuses on online teaching of Chinese compulsory education content.

Market

As of March 2020, the number of online education users in China has reached 423 million, and the number of daily active users of multiple online education applications has reached more than 10 million. With the deepening of people's awareness of online education, the scale of this market will continue to **grow**.



The scale and growth rate of online education users in China
Source from: Aimei Web

What Kids benefit from online Education

Although both teachers and students believe that the quality of online education is not as good as offline, there are a handful of their students are doing better with remote learning than they were doing in the physical classroom. (Fleming, 2020)

Shy kids

- Private space makes them comfortable



Image from: https://media.edutopia.org/styles/responsive_2880px_original/s3/masters/2020-04/DSC_0054.jpg

Creative kids

- Online resource are more plentiful

Self - motivated kids

- Arrange work schedule

Benefits and Disadvantages of Online Education

Benefits:

1. Open
2. Adaptive
3. Flexible

Disadvantages:

1. Isolating
2. No competition
3. Must have self discipline

The future of online education - Why Meaningful

Online education can to some extent alleviate educational inequality with it advantages.

More and more students and their parents choose online tutoring. Students attend the online classes at their home after class.



It is expected that in the future, online education will exist as an auxiliary to offline education for a long time.

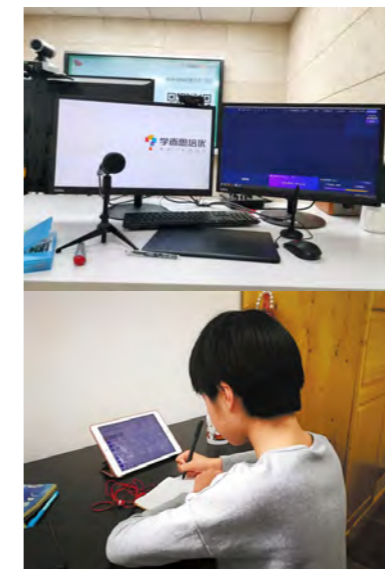
Current situation of online education

According to Chinese Education Association, more than 75% of K12 students attended extracurricular classes. Due to the continuous improvement of the online education industry, more and more parents choose online education institutions(OEIs) to improve their kids' grades.

This project mainly research the experience of students attending online classes of online education institutions.

Teachers in online education institutions utilize various professional devices to present live classes for students remotely.

Students attend the live classes at home. Different students use different equipment to watch the videos. They often sit still in front of the screens for more than one hour.



General Problems

According to Xiao Kong, the researcher of Tsinghua University, his team surveyed thousands of logs of students attending online classes and summarized the following typical problems in online education:

1. Low efficiency

Communication online inferior to face to face

2. Less qualitative feedback

Teachers reduce exams, homework and tutorials.

3. Reduction of incentive

The learning atmosphere at home is not as good as at school.

The obvious reason is that most people are trying online education models for the first time who are unfamiliar with online education.

Focused Age Group

Compulsory education in China consists of primary and middle school. Nearly 80% of middle school students choose to take extracurricular classes. The elementary school curriculum is mainly interest-driven, while the middle school one balances academic requirements with fun.

I prefer to researching middle schooling.

Primary Stakeholders I choose



Teachers
Online Teaching
Working in OEIs

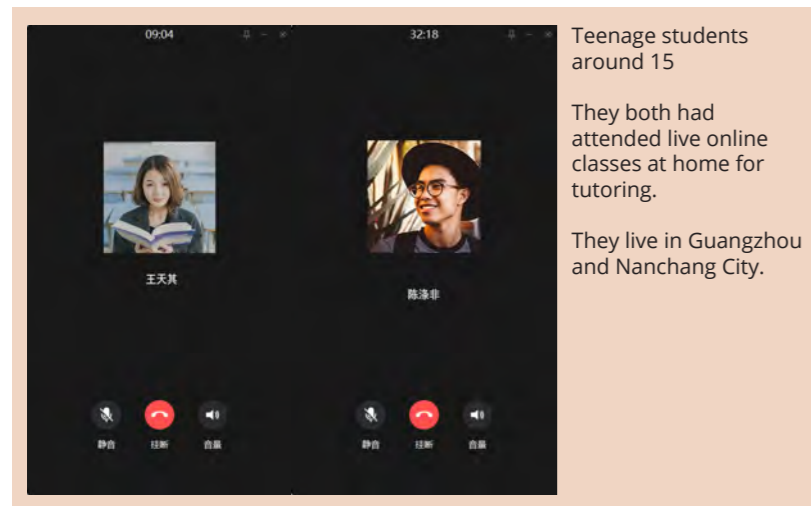


Students (12-15)
Online Learning
Studying at home

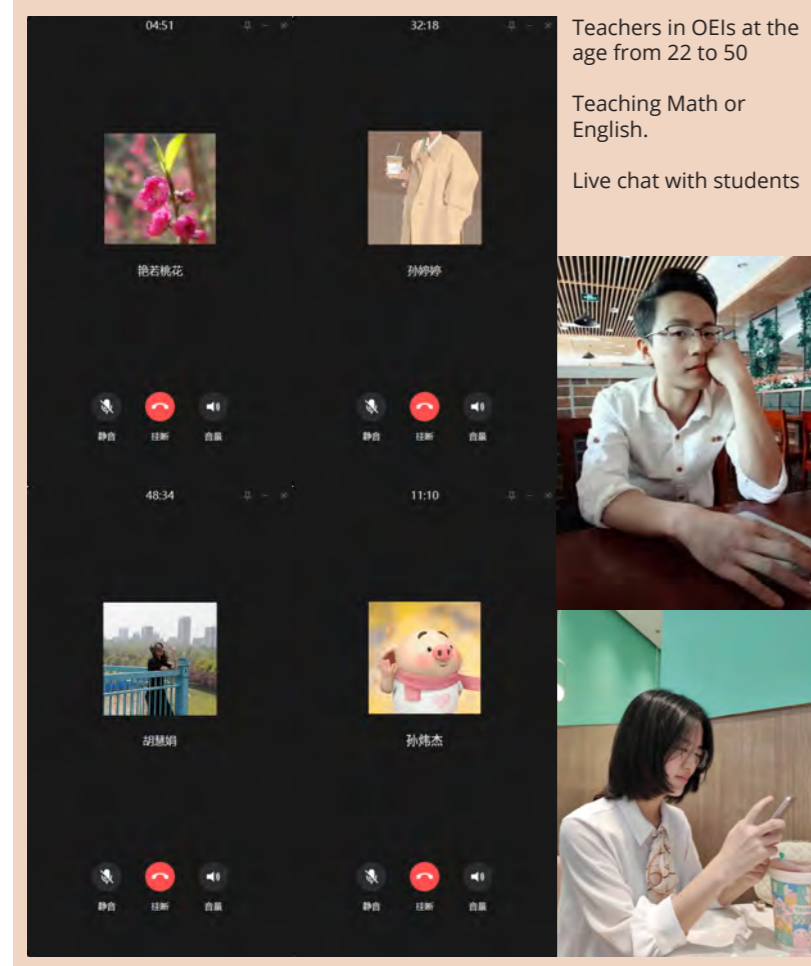
1. Interviews

In this part, I interviewed with 6 teachers working on OEIs and 2 teenage students who had experience of online learning. I conducted in-depth interviews with each person for around 1 hour each. I wish to understand how their experience of online teaching and learning is, and find out the potential insights.

For teachers, I mainly asked them how they get the feedback from students distantly and what is different from online teaching. For students, we discussed how their daily life while attending online classes and how they arrange their time without mandatory schedules from schools.



Teenage students around 15
They both had attended live online classes at home for tutoring.
They live in Guangzhou and Nanchang City.



Teachers in OEIs at the age from 22 to 50
Teaching Math or English.
Live chat with students

Key Findings

From Students Perspective:

1. Tutorial
Asking teachers questions face to face is clearer, especially about Geometry.

2. Concentration
Teachers follow the slides without considering the acceptance of the students. It's easy to get lost.

3. Detailed explanation
Normally, the outcome is presented straightly without rigorous process.

4. Schedule
The irregularity of work and rest time at home leads to inefficient study.

5. Too casual
They take classes in various states, even lying in bed. Sometimes they do other things in a class, which is not allowed in offline classes.

From Teachers Perspective:

1. Supervision
There is no mandatory requirement for all students to turn on the camera.

2. Unreliable feedback
Quizzes online substitute paper exams.

3. Lack of interaction
Teachers obviously feel that many students are absent-minded but could do nothing.

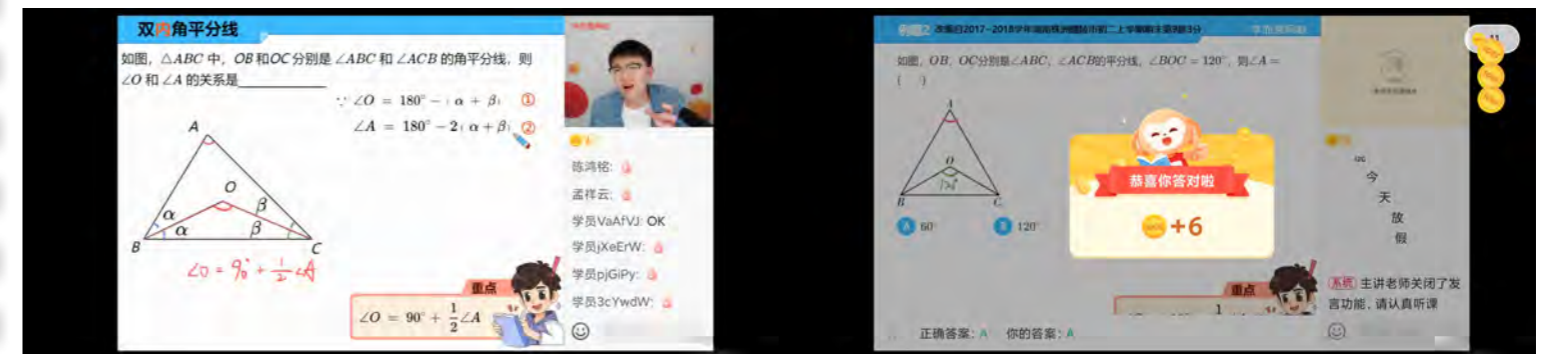
2. Attending a real live class

In this part, I completely attended some live online classes of geometry for middle school students. I played as a middle school student to obtain these knowledge and dug the following findings out from my own perspective.



1. Teaching time too long
Usually a class lasts an hour and a half without a break.

2. Video games of lectures
Playing video games on class can help relax, require concentration and stimulate creativity.



3. Taking notes to summarize points
Teachers move on quickly and students need to take more notes than offline classes.

4. Rewarding
Virtual gold coins with BGM of falling coins for answering correctly make students engaged and satisfied.

3. Targeted User

Teachers can share their experiences with experts and colleagues to improve the quality of online teaching. From the above research, the bad experience of online education has a greater impact on students. In particular, some students indicated that online tutoring did not significantly improve their grades. A suitable learning environment is what gives students the motivation to keep learning.

Through deeper research at this stage, I choose the **Middle School Students as my targeted users**. In the next stage, I will research this group deeper.



Image from: <https://img2.chinadaily.com.cn/images/202003/17/5e702f2ca3101282065de053.jpeg>

User Research

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1. User Scenario

I observed one middle school student who taking online classes at his study room. Combined with my own experience in online classes, I think his case can typically reflect the scenario of a middle school student in a live online class. Therefore, I built a User Scenario to illustrate how his experience is and what potential points I might need to intervene.



8:00-9:00
Pre-class

He Previewed the lectures before the class.



9:30
30 min

Around 30 minutes, he felt thirsty and tired, and he drank a Coke.



10:00
60 min

He had been sitting for one hour without a break. He lay on the sofa to rest just "listening" to the teacher.



10:30-
After-class

He organized his notes and prepared for the next class asked by his tutor.

Stages

Time

Actions

Emotions

Positive

Negative

2. Compared to Physical Classroom

1. Structured & disciplined setting

The entire class-time is dedicated to teaching and learning. Teachers and students follow the schedule arranged by the school, so their work and rest are very regular.

2. Paying more attention to the lecture

The teacher will be able to understand if each student is getting the point correctly by asking questions which require students' fullest concentration.

3. Social interaction among students

Due to face-to-face recognition, offline classes provide a large range of scope with classroom discussions, debates. It helps to broaden students' understanding of what is being taught in class and can have references on different perspectives.



Image from: <http://img2.chinadaily.com.cn/images/202004/17/5e98ea08a3105d502d9f06af.jpeg>

Peak End Rule

According to Daniel Kahneman, when the user's emotion drops down, there might be a potential design point to intervene.

In the above diagram, I need to pay more attention on at the time of 9:15 and 10:15 for the middle school student.

Key Findings

1. Duration of concentration

For middle school students, the general duration of focusing is around 15 minutes.

2. Relaxation and rewarding

Drinking a Coke or sleeping for a while that are not allowed in physical classrooms are of benefit of restoring concentration.

3. User Consideration

According to Professor Hu from Beijing University Of Technology, when designing a product to interact with adolescents, there are several factors should be taken into consideration. Combined with previous user research, I list a hierarchy as below:

1. Interactive
2. Engagement
3. Initiative
4. Enjoyment
5. Easy to use
6. Ritual

Initial Ideas

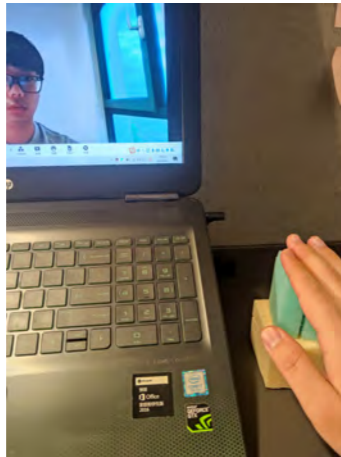
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1. Possible Design Directions

From the above key findings, I generated several insights and produced corresponding proposals. User tests and interviews with rough prototypes to get qualitative feedback is to select the appropriate concept to move forward.

Concept 1

Insight:
Teachers and students commonly considered that the quality of offline teaching is better.



Proposal:
Simulating the context of answering questions at physical classroom with a bulb.

Feedback

-Advantages:

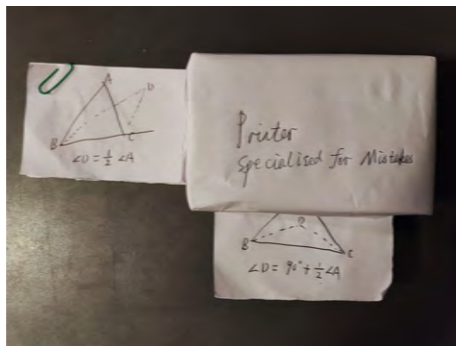
1. Encourage students to preview;
2. Make the online classes lively.

-Disadvantages:

1. It might interrupt the process of teaching.

Concept 2

Insights:
1. Online quizzes are less qualitative feedback;
2. Students taking more notes while online learning.



Feedback

-Advantages:

1. Do not need to take notes with plentiful texts;
2. Making a collection of mistakes.

-Disadvantages:

1. The common printers can do the same thing.

Proposal:
Print the exams or lectures in paper form.

Concept 3

Insight:
Students are prone to visual fatigue from staring at a screen for a long time, which leads to distraction.



Feedback

-Advantages:

1. Easy to use;
2. Students did need to replenish and relax on class.

-Disadvantages:

1. It might bother students studying.

Proposal:
The timer with replenishing energy to help student arrange work schedule;

2. Kano Model

I used Kano model to analyze the relationship between user needs and user satisfaction. According to the user feedback, three concepts proposed previously are hierarchized in the diagram below.

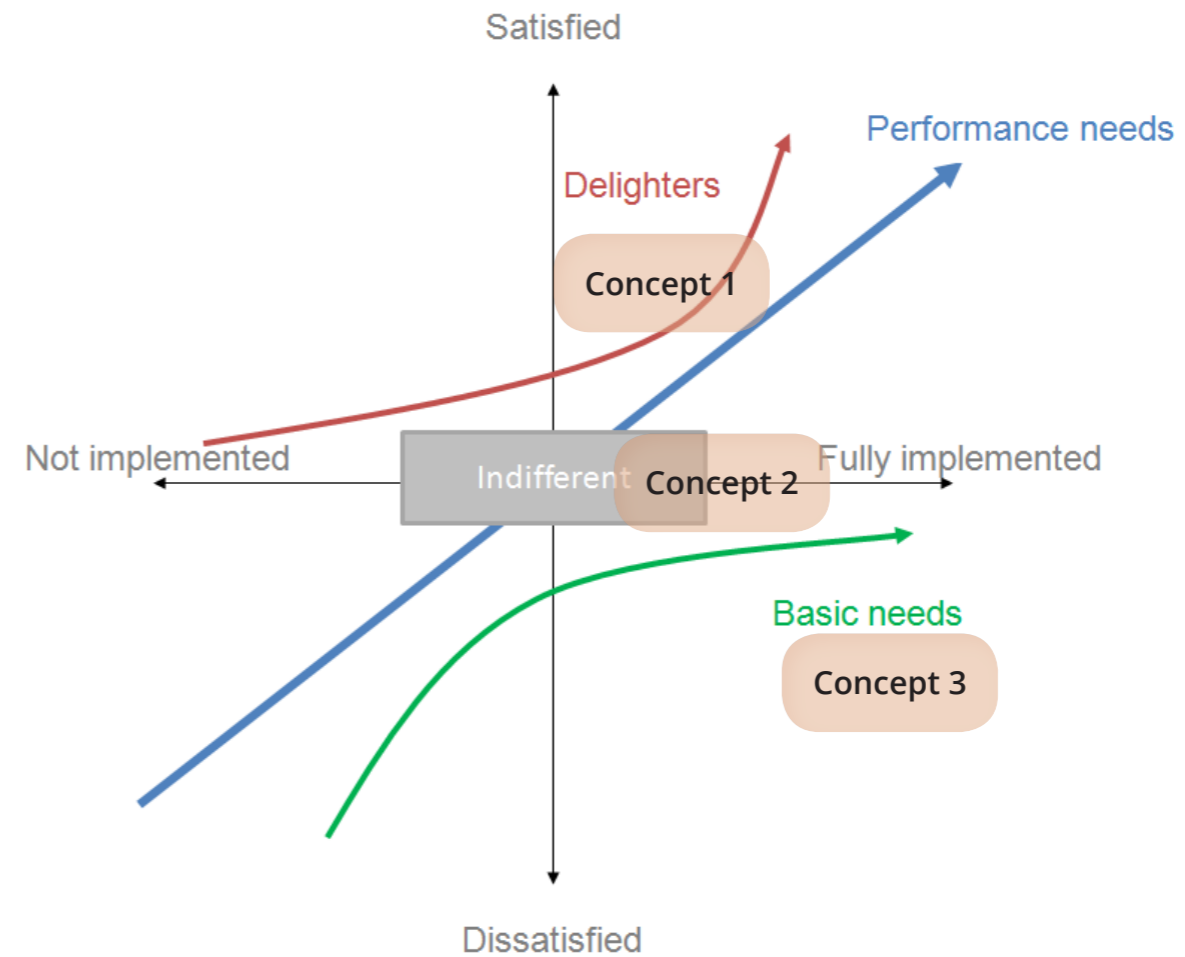


Image from: https://upload.wikimedia.org/wikipedia/commons/c/c7/Kano_Model.png

Based on the principle of hierarchy of user needs: Basic needs > Delighters > Indifferent. The concept3 is most promising to move further.

3. Design Opportunity

1. What if the students could arrange their work schedule with a more interesting and interactive way...
2. What if there is another interaction between teachers and students besides online communication...
3. What if the teacher set time for students as offline schooling...

4. Pomodoro Technique

- The basic principles of Pomodoro Technique:
1. Work for 25 to 30 minutes at a time with a five-minute break;
 2. Complete one task at a time;
 3. Loop three or four times is optimal;
 4. Rest longer after studying one hour.



Image from: https://live.staticflickr.com/7112/6969282632_bc5249a9a6_b.jpg

Ideation

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1. WWWWH - Define the problem

-Who

Middle school students attending online tutoring, also connected to teachers at OEs.

-What

Students are easily distracted because an online class usually lasts for more than one hour without a break leading to low efficiency. The too casual atmosphere of their own rooms make them indolent.

-Where

Around the desk at the study room

-When

On online classes

-Why

The brain needs relaxations and rewards while studying for a long time

-How

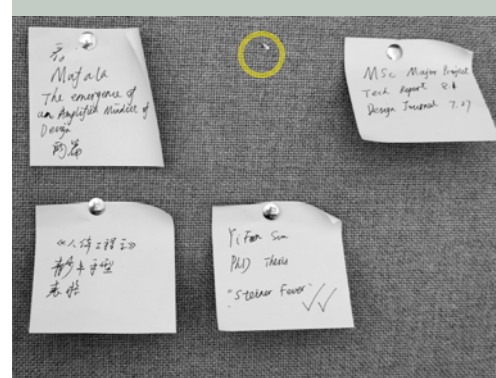
Provide an enjoyable interaction way with the teachers for students; they could replenish energy as rewarding and continue concentrating on the lecture.

Why not just taking a break as the offline schooling?

1. Usually the lecturer arranges too much contents, which makes the students feel satisfied with the money they pay to attend the class;
2. Students who take extracurricular classes during the holidays would like to finish school early;
3. Parents may complain if they see their children take frequent breaks during tutoring.

2. Case Study

I analyzed the existing products tangible or intangible to find the potential improvements conducting my following design.



Post-it

Bad experinces:

1. Forgetting to do the lists;
2. Damage to the wall;
3. Environmentally unfriendly.

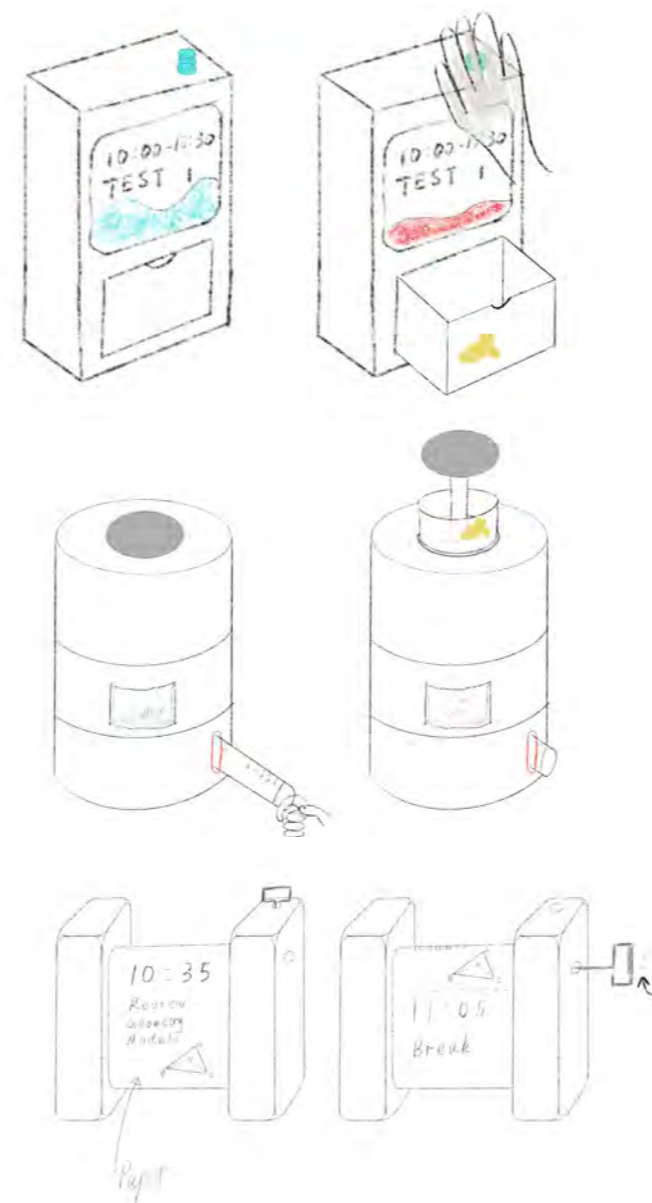


Timer APPS

Bad experinces:

1. Using phones not just as a timer but other purposes;
2. Annoying alarm;
3. Boring to set timing each time.

3. Further Ideas



Idea1 - Timer

1. The color ink screen displays like paper. It won't disturb students.
2. When the time running out, the student push the button down, the drawer pops out automatically.

Idea2 - Time ruler

1. Inspiration from Vintage timer. Pull the ruler as setting time.
2. When the time running out, the box on the top rises slowly, the student could get the snack in it.

Idea3 - Film of To-do List

1. The student write the to-do lists by his/her own self. To create a ritual while studing for online classes can help focus and concentrate.
2. Inspiration from film. Use the tiny wrench to roll the paper film with to-do lists written on.

4. Criteria for selection

I established criteria based on the user consideration and user needs in the context of online learning. Investigations and discussion with targeted users conducted the weighting(0~5). It is indicated that **idea1** is best.

	Weighting	Idea1	Idea2	Idea3
Interactive	25%	5	4	4
Enjoyment	25%	4	3	3
Easy to use	20%	4	3	3
Quiet when running	15%	3	3	5
Unobtrusive	15%	4	3	4
Total	100%	4.1	3.25	3.7

5. Next steps

1. Confirming the key functions of the product;
2. Considering ergonomics related to the products;
3. Determining how the student interacts with the timer and the teacher engages remotely.

User Tests and Human Factors

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Key features

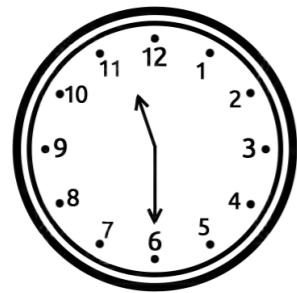


Set Time for assignments



Reward and encourage students

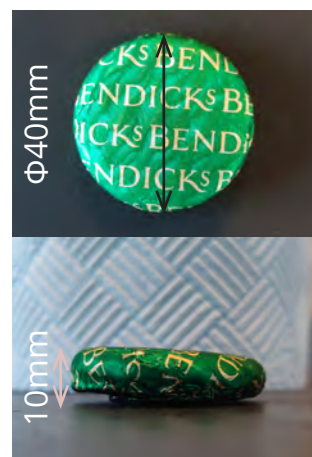
Digital watch VS Analog watch



I invited several peers to read the time on these two watches which are, digital watch and analog watch, the most two popular forms of presenting time. Most of them can tell the time within 1 second. However, analog watch cost them more than 2 second.

It can be conducted that the efficiency of reading time on **digital watch is twice on analog watch**. So I choose the form of digital watch to be used on the product.

The reward



From my observation, students usually prepare water in class. Teenagers are more fond of sweets. I think chocolate is a nice choice as a reward.

Mint - Refresh the mind
Chocolate - Replenish energy

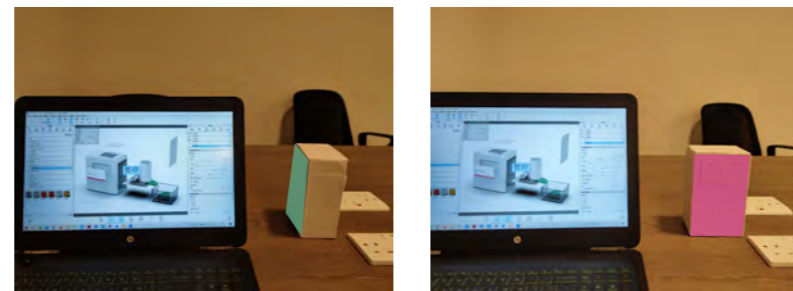
I choose the BENDICKS brand popular in UK.

The direction of the screen toward users

Although the digital watch is easy to read, I don't want students to be distracted in class because they often look at the time.

Therefore, I adjusted the place of the screen. The screen can be seen clearly but not attract too much attention.

(*More than 99% of chinese are right-handed users)



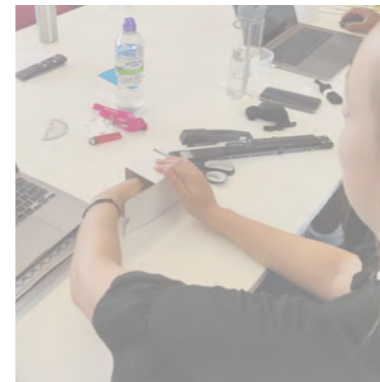
The way of picking the chocolate out

I assumed three possible ways to pick the chocolate out. Then, I did the user tests and found that picking it out from **the top** is the most **comfortable** way.

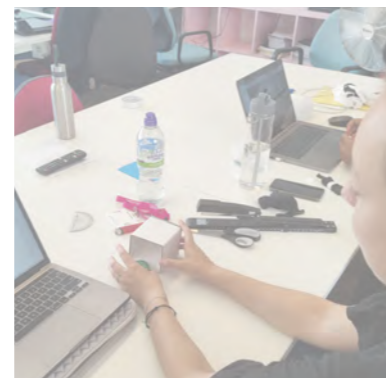
1. From the top



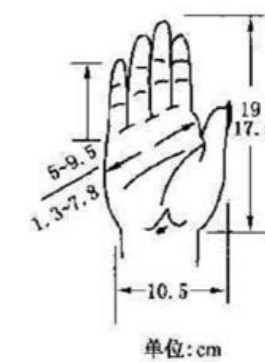
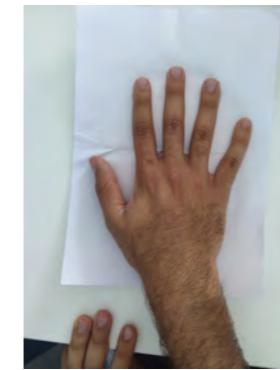
2. From the broadside



3. Rolling out of the door



The size of the box



For confirming the size of the product, I need to estimate the size of the drawer first.

I invited Bassel for the user testing. He is an Egyptian. His hands are obviously bigger than my hands. Checking the ergonomics of hands of Chinese adolescents, the size of his hands are bigger than 95% of them. If the product fits him, it also fits for almost Chinese Middle School students.

The sizes of boxes I tested:

50*50*50; 80*80*80; 100*100*100; 150*150*150; 180*180*180.

The optimal size is that the bottom area is approximately 80*80 and the height is around 50 to 80.

Then the size of the timer profile is presumed as 90*200*200.



The size and appearance of the product is basically determined. In the next step, I focused on the engineering part how to make the chocolate emerge in the drawer. Simultaneously, I figured out how to control the timer in different areas.

Technology

1. Methods of the timer delivering the chocolate

I list three possible ways as followed about how the timer deliver the chocolate.

1.1 Belt conveyor



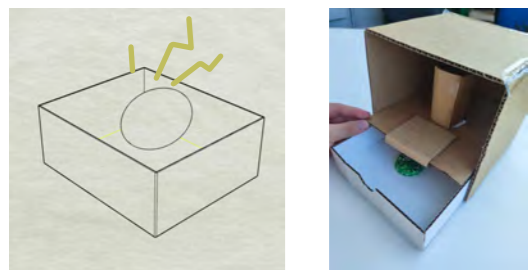
The door is connected to the shaft. When the belt rotates counterclockwise to a certain angle, the door will open and the candy will be delivered to the door.

-Advantages:
Smoothness and high load capacity

-Disadvantages:
The installation of the belt and of the motor will make the whole product comparatively large. The belt transmission is easy to slip, and it is impossible to turn and stop sharply.

Therefore, I quit this scheme.

1.2 Falling through a hole

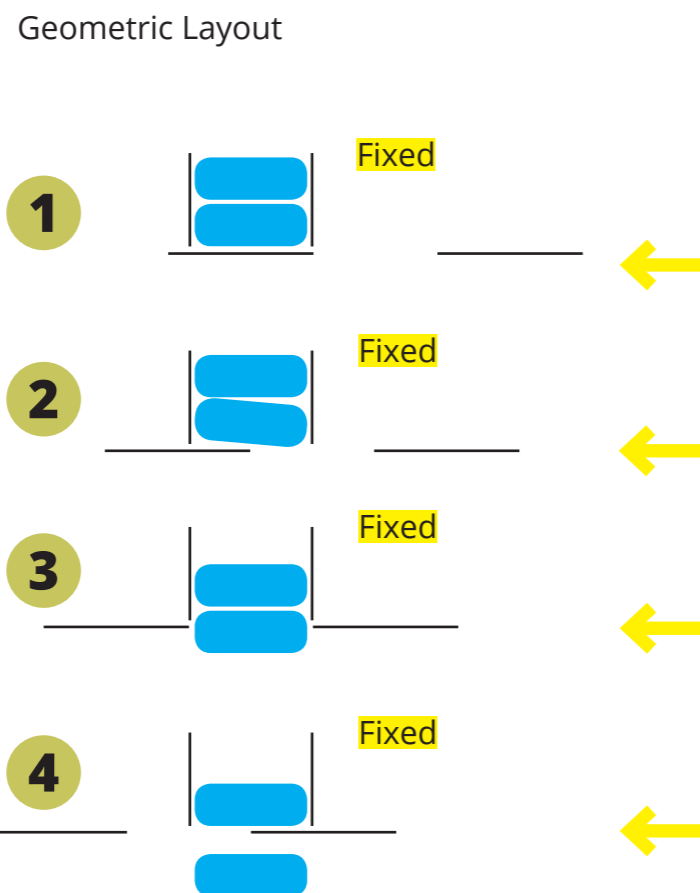


I changed the previous scheme to make the chocolate fall through a hole **one by one**. The chocolate dropped into the drawer can interact with the user with **sound** as reminding and rewarding.

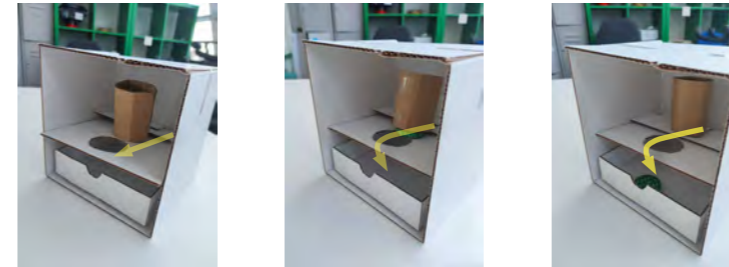
-Advantages:
Theoretically feasible

-Disadvantages:
No appropriate motors transmitting the plate with the precise speed to achieve the chocolate falling one by one.

I kept this concept but need to improve.



1.3 Improvement based on the second scheme



(*The sleeve should have been connected to the top of the box due to no more cardboards and glue to fix the sleeve in the studio. With time constraints, I did not rebuild the models. The pictures just illustrate how to work.)

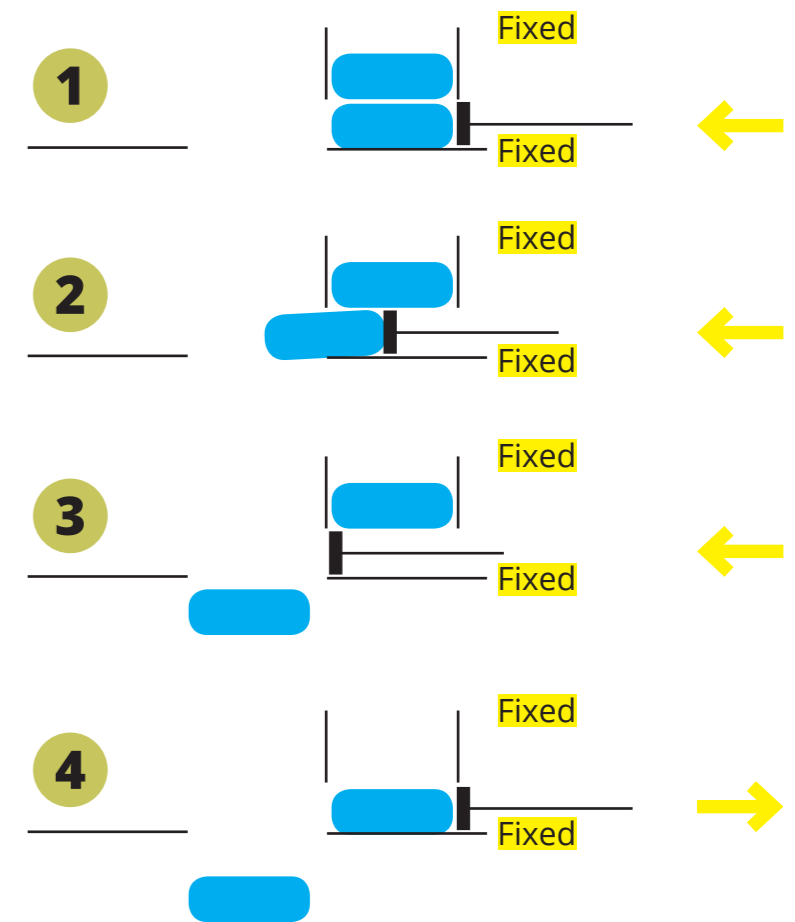
The sleeve containing chocolates and the plate with a hole are both fixed. There is another plate to push the chocolate falling into the drawer. The distance between the sleeve and the plate should be a chocolate height.

-Advantages:
The speed of the plate does not need to be considered too much.

-Disadvantages:
Need more slots and stiffeners to support the components.

It is illustrated that the chocolate would be pushed into the drawer through a hole one by one successfully. Above all, I choose this scheme!

Geometric Layout



The rack and pinion transferred by a DC brushed motor compose the moving plate.

2. Remote Control System

In the context of my design, I assumed that the teacher could control the timer and assign tasks for students. Therefore, the timer needs to contain a distance communicating module.

Remote control is built on WiFi technology and other wireless communication technologies to connect intelligent devices and control systems, ultimately realizing remote transmission of data and wireless control of devices.



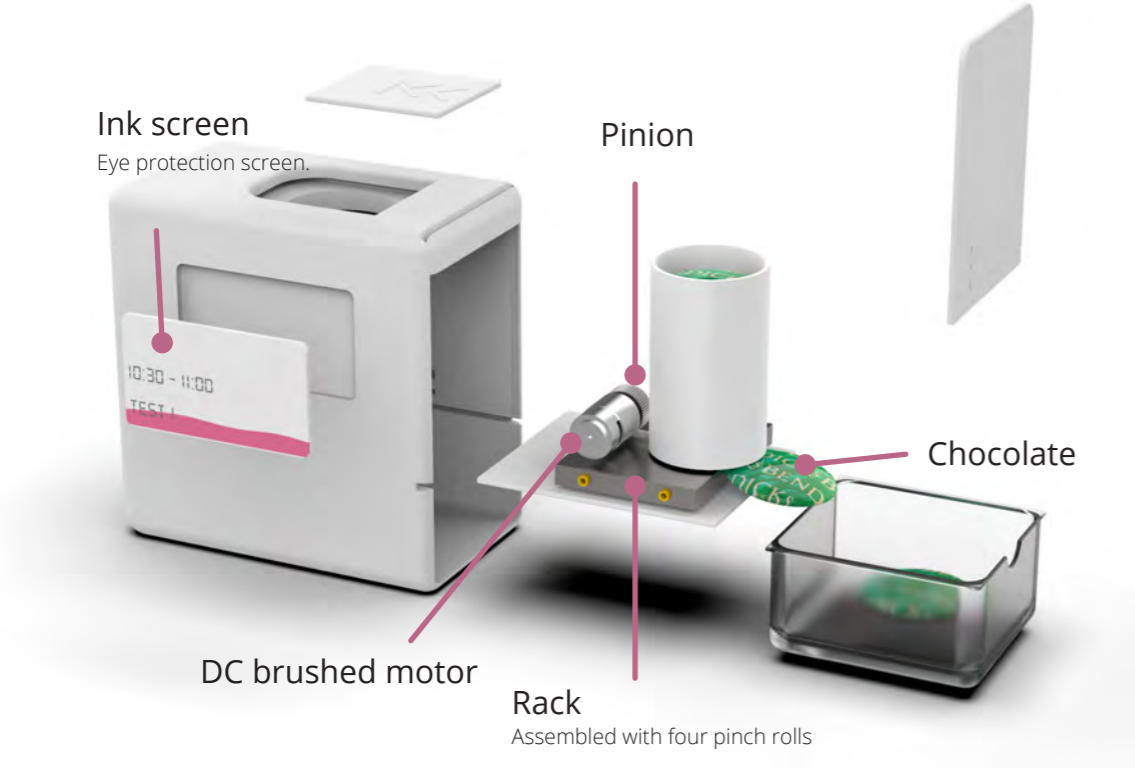
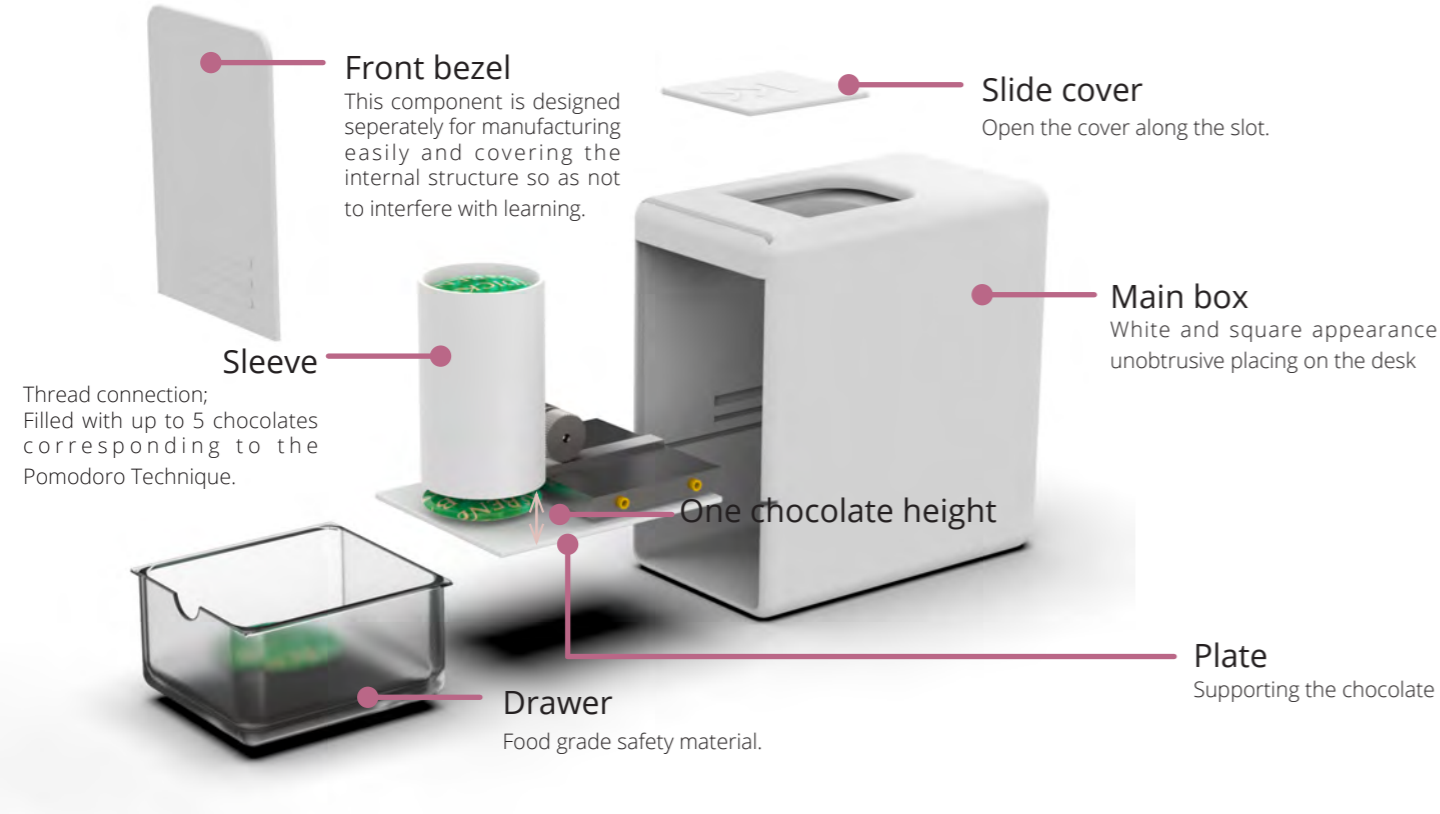
Image from: <https://www.publicdomainpictures.net/pictures/280000/velka/smart-home.jpg>

*The detailed work about engineering of the product is written in the Technical Report.

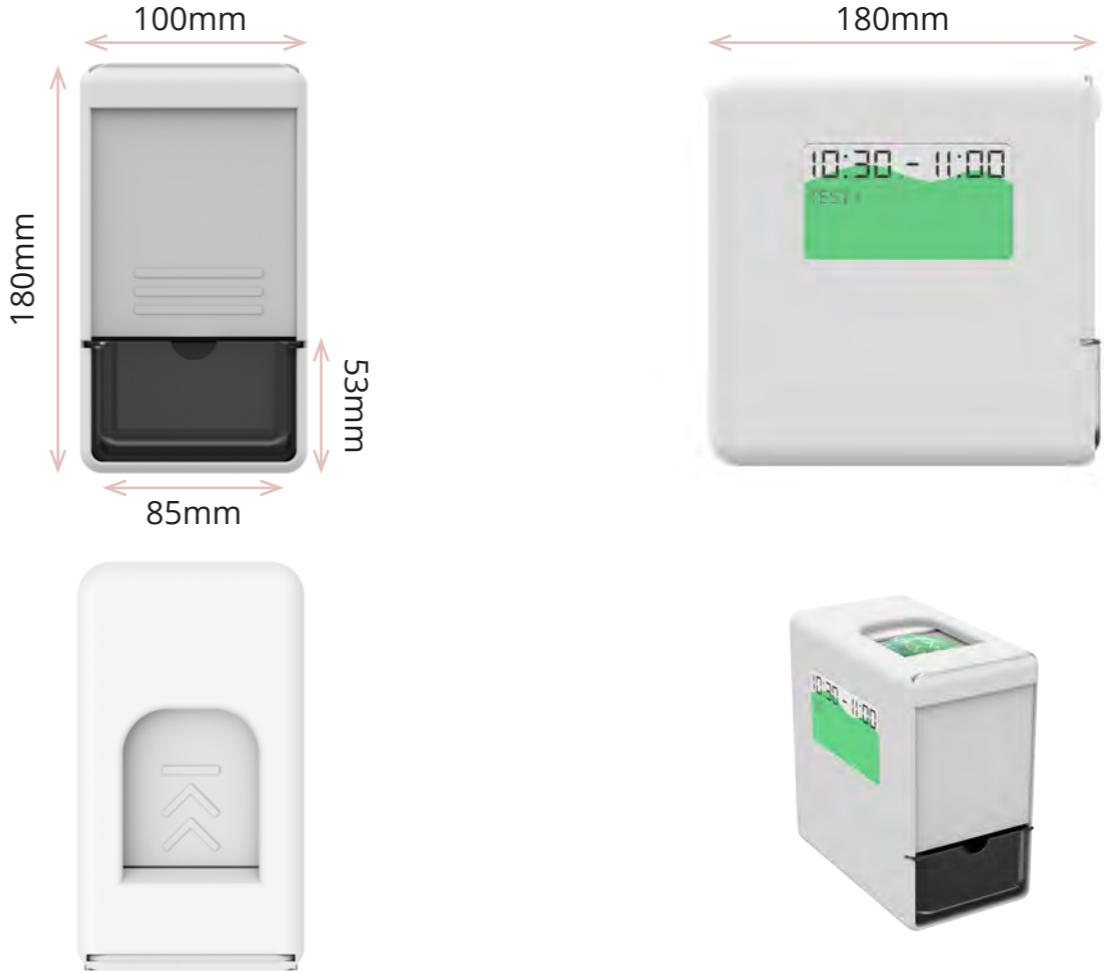
Final Design

Design Brief

The timer with chocolate dispensing provides an enjoyable interaction way to arrange time and help to relax and replenish energy. It connects to the teacher distantly. The Teacher assign tasks for students like in offline schooling. The student will be rewarded for completing tasks carefully.



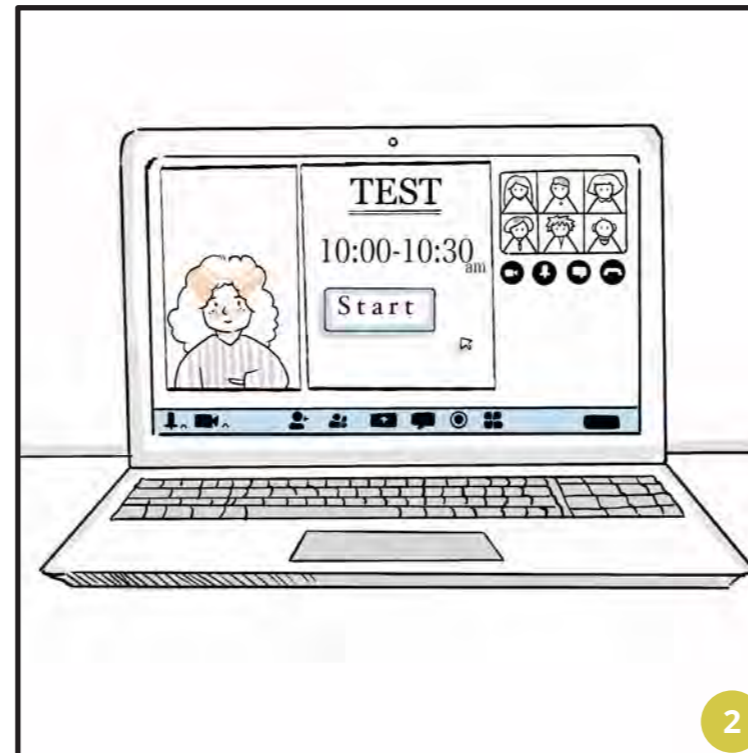
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Design Benefit The timer support another interaction besides normally virtual communication. It could help students develop and maintain good study habits.



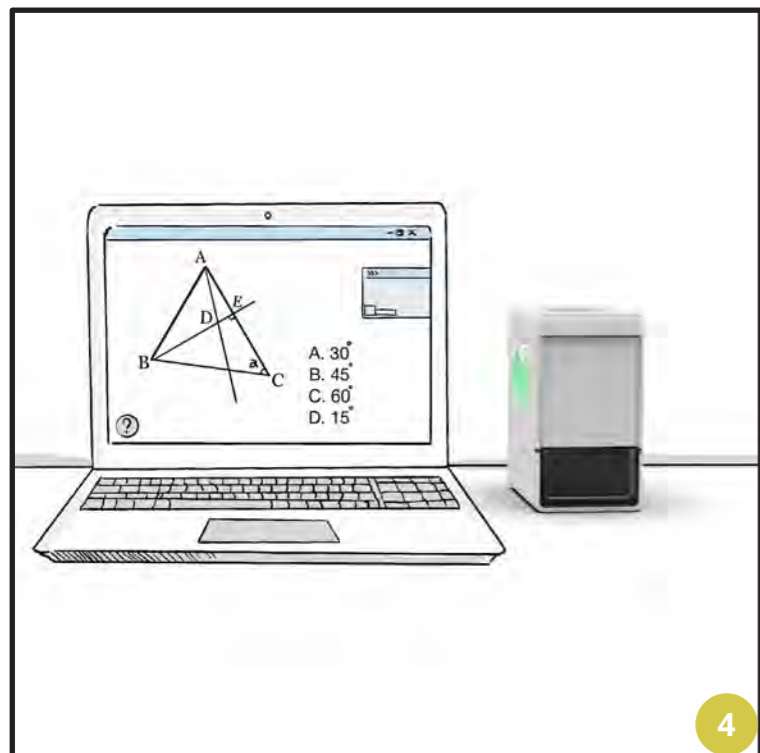
1 At the start of the online class, the teacher asks the students to put the chocolates one by one from the top of the Timer.



2 The teacher realizes the students are not listening carefully, so she assigns a quiz to the students online, sets it for 30 minutes and starts timing it.



3 After about 30 minutes, the student feels a little tired due to no break. But the timer receives the task assigned by the teacher.



4 The student begins to complete the quizzes assigned by the teacher in earnest.



5 When time is up, a chocolate falls into the box. The student heard the sound of the candy falling into the drawer, and pick it out as an award.



6 After eating the chocolates, the student perks up and continues to listen carefully to the lecture.

Summary

1. Conclusion

The aim of this project is to design a product for Middle School students attending online classes of OEds to improve their experience while online learning.

I generated three concepts based on the key findings extracted from the previous user research and desk research. According to Kano Model, I chose the concept of the timer to move forward. Then I defined the problem more specifically and reproduced more ideas related to the problem. Through weighting these ideas, the timer with chocolate dispensing was selected. User tests were conducted to determine the details of the product and refine the interaction in terms of human factors. When the scheme is finalized, the engineering parts should be considered. Last, I delivered the final product design and a storyboard.

I sent my work to the targeted users and discussed with peers. They all gave me qualitative positive feedback. To sum up, this product achieves the design goal.

2. Reflection

1. The topic I selected for Major Project is kind of broad. There was too much content to investigate in the early stages, but it was difficult to determine a specific direction to dig deeper.

2. In the mid-term, I was limited to the field of mathematics, but never found a solution that was better than the existing products. At this point, I should give up decisively, look for new directions, and come up with new ideas.

3. Focus on more qualitative user research rather than quantitative.

4. Establishing more strong logic line make the product more persuasive.

Future Work

1. Add some personalities on this product for the target user group.

2. The detailed of mechanical engineering design should be continued.

3. Make the product implemented in the physical world.

References

1. Bates, T. (2014). A short history of educational technology. Retrieved from <https://tonybates.wpengine.com/2014/12/10/a-short-history-of-educational-technology/>
2. Singh, V., & Thurman, A. (2019). How many ways can we define online learning? A systematic literature review of definitions of online learning (1988-2018). *The American Journal of Distance Education*, 33(4), 289-306. <https://doi.org/10.1080/08923647.2019.1663082>
3. KONG Xiao, LIU Naijia, ZHANG Menghao, et al. Analysis of online college teaching data before and after the COVID-19 epidemic[J]. *Journal of Tsinghua University(Science and Technology)*, 2021, 61(2): 104-116.
4. Przybylski, A. K., & Weinstein, N. (2019). Digital screen time limits and young children's psychological Well-Being: Evidence from a Population-Based study. *Child Development*, 90(1), e56-e65. <https://doi.org/10.1111/cdev.13007>
5. Hu, H., Zhou, Z. and Jin, Y., 2021. EDUCATIONAL PRODUCT DESIGN FOR CHILDREN WITH ADHD FROM THE PERSPECTIVE OF MULTIMODAL INTERACTION. *Design*, 34(11), pp.88-91.
6. Dumford, A. D., & Miller, A. L. (2018). Online learning in higher education: Exploring advantages and disadvantages for engagement. *Journal of Computing in Higher Education*, 30(3), 452-465. <https://doi.org/10.1007/s12528-018-9179-z>
7. Ding, Y. (2017). *Human Factors*. 5th ed. Beijing: Beijing University of Technology Press.
8. Lee, J., Wickens, C., Liu, Y., Boyle, L. (2017). *Designing for People: An Introduction to Human Factors Engineering*. 3rd ed. Charleston: CreateSpace.
9. Jordan, P. W. (2003) *Designing pleasurable products: an introduction to the new human factors*. Taylor & Francis.
10. Do, A. M., Rupert, A. V., & Wolford, G. (2008). Evaluations of pleasurable experiences: The peak-end rule. *Psychonomic Bulletin & Review*, 15(1), 96-98. <https://doi.org/10.3758/PBR.15.1.96>