

## *Mass Learning Through Interactive Public Art With Data Sculpture*

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### **Abstract**

An interactive public artwork “English 8 minus 2” was researched and developed by relaying the IoT technology and mass learning principles. This artwork mainly aims at providing students on campus with the opportunity to learn English by installation artwork, which expects to reduce 2 credits from the original 8 credits of English score accordingly. The installation comprises ten LED light pillars, offering two display modes: a light art exhibition and an English learning mode. Moreover, students’ results of English learning in each department will also be reflected at the regular time. In this regard, those engaged in the artwork are not only statically immersed in the aesthetic feeling with the alternation of light and shadow brought by the artwork, but also interacting with the artwork by themselves. Furthermore, we delve into the potential of “English 8 minus 2” to generate motivation, drawing upon the "Self-Determination Theory" proposed by Professor Edward Deci. Additionally, we analyze whether the artwork can bring socio-pleasure, employing Lionel Tiger's framework of pleasures. We anticipate that this interactive learning method, which merges “public art” and “mass learning,” will be applied in more public spaces in the future.

Keywords: IoT, Mass Learning, Public Art, Interactive Installation, Data Sculpture, SDT, Socio-Pleasure

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## Introduction

Since being generated, data operation has played an invisible role. The data is actually stored in the cloud, computer, mobile phone, or various software. With considerable computing speed, it helps us solve the tough and tedious problems confronted by us. We are deeply attracted by such invisible power. The in-depth significance and influence hidden in data will be unveiled if the invisible data operation is presented in a visual way by relying on data transformation so that everybody is able to see, experience, and appreciate it in daily life. When it comes to our research, the relevant data is embedded in art installations and public fields so that participants will be able to experience and understand it. At National Tsing Hua University, every student must complete 8 credits of English courses before graduation, which is very difficult for some students. So, we want to help students learn English and inspire them more motivated, We created an interactive installation artwork and designed this “English 8 minus 2” interactive artwork to provide students on campus to make learning English easier and more fun. By the way. Our installation includes participants’ interaction result data, this data is massive, so it is like big data, and we input them into an installation it is just like Data Sculpture. We build this interactive artwork, if one of the college’s students can reach the highest score, the university administration will consider granting 2 credits for that college for free.

For these reasons, we want to help students achieve this goal. We designed the “English 8 minus 2” installation. It consists of 10 LED light pillars, offering 2 display modes: an English learning mode and a Light art mode. We use IoT technology and mass learning principles to stimulate learning and motivate students. When students achieve the highest score in English learning mode could have 2 credits for free, and then students can reduce by 8 credits, making graduation easier. To use this installation artwork, we have three play modes of learning and presentation. One is English learning mode, on-the-hour light art mode, and dynamic light art mode. Regarding the English learning mode, students need to give answers to English questions by mobile WebApp. When the user scans a QR-Code, and then opens WebAPP, the web app will show some vocabulary questions for the user to click the right answer. One right answer will light up an LED light. Each score for each question is further translated by the IoT program of the cloud server and displayed on the LED light represented, as shown in Figure 1. Students can play with transformed installation art on campus and form a group to learn and make a competition. In this way, they are able to generate a great deal of learning motivation and incentive effect for students on campus.

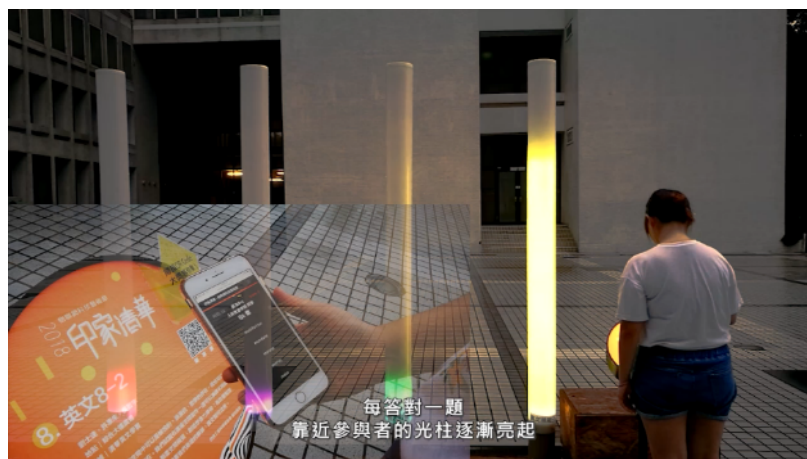


Figure 1: This is an “English 8 minus 2” installation and light-up form a right answer.

In light art mode: On-the-hour light art mode is used to display the performance status of English learning. The other one is used to perform dynamic effects at a specific time. To sum up the above modes, we not only make an installation for English learning. We also used the “Self-Determination Theory” [1] proposed by Prof. Deci & Ryan to discuss the intrinsic and extrinsic inspiration of the English 8 minus 2 events. Besides, we used Tiger’s four Pleasure Theory [2] to discuss students playing English learning mode and appreciating light art mode.

## Related Work

In 2008, Zhao and Vande Moere [3]. From their perspective, Data sculpture is a physical artificial product. Its objective is to provide the public artwork with data and understanding related to social interaction. In this related work, we are also using the Data of English learning mode results to build a Data sculpture, and that could be a public social interaction mode. The “Data Gate” Development team from Ouch New Media Studio in 2020 [4]. This artwork is considered the first public art of data sculpture for NASA research on artificial intelligence astronomy. It is actually based on the AI technology of the NASA Kepler dataset. The same artwork creation form artist Matthew, created “As We Are” artwork in 2017 [5]. It is a gigantic head-shaped installation that rotates through a database of 3D portraits, including local residents of Columbus and visitors. It is a huge 3D display device that is able to digitally copy the faces of participants. Two cases use the Data to transform an installation like Data sculpture, as shown in Figure 2. We want to use these ideas for our “English 8 minus 2” interactive installation.

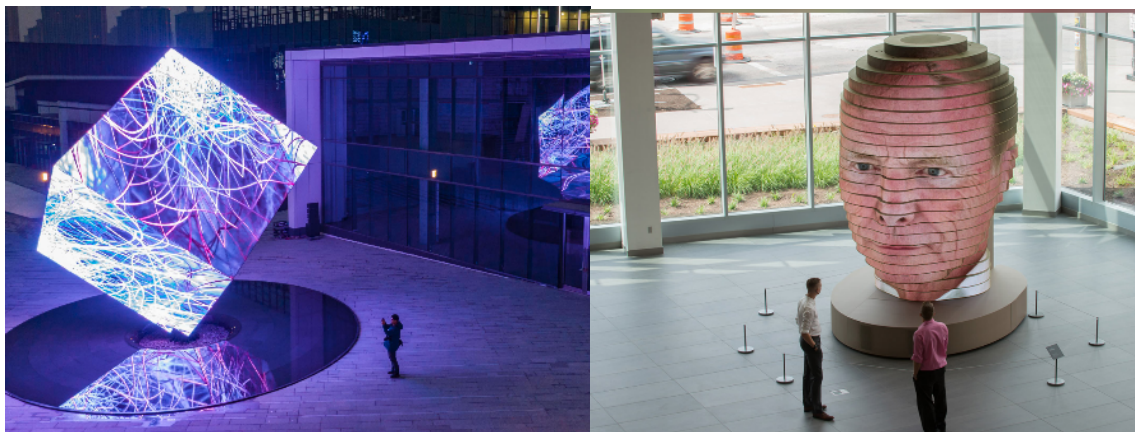


Figure 2: “Data Gate” (Left) and “As We Are” (Right) installation artworks.

In 2021, the New York artist, Jen Lewin created “The Pool.” [6] This artwork using a huge circular field consisting of multiple interactive LED lighting pads shows an aura of effects in the public artwork. Such artwork is a mass interactive type with the purpose of triggering mass pleasure. The interactive effect of lighting is considered the basis for mass learning ability. In 1999. From the perspective of Deborah Kilgore, “collective learning” [7] happens among two or more different people, so the common significance is actually established and the relevant action is taken by the collective. In this research, it points out “mass learning”, since the “collective.” In our research, we use “interactive LED lighting” and “Mass learning” to consist randomly and it is diversified without a fixed team being constructed. Moreover, the individuals interacting with each other in this artwork do not know one another. We survey these related works to find out mass learning and interactive public artwork with data sculpture between related English 8 minus 2 artwork relevant and possible.

In SDT theory, [1] we use extrinsic/intrinsic motivation to find out user self-determination. In this installation, we define extrinsic motivation for mass learning and intrinsic motivation for interactive WebAPP. In pleasure theory, We use these four forms of pleasure and our artwork relation [2]. Physio-pleasure: is the pleasure of the body that may see, hear, and touch. On this level design elements such as comfort durability, wearables, etc. It's like our LED light pillar effect. Psycho-pleasure: is about the user's reactions and their psychological state of mind at the behavior level. It's like our English Learning mode for answering questions. Socio-pleasure: can be seen in the form of rational behaviors at a reflective level of design, also effective installation for sociability. It's like our installation for mass learning. Ideo-pleasure: rely on aesthetics and embodied values in an installation. It may be rooted in psychology, user experience, or environmental elements. It's like our installation artwork and light art mode.

## Methodology

About this artwork methodology: This interactive artwork “English 8 minus 2” is installed at the Pigeon Square of NTHU, which consists of 10 side-by-side LED pillars, Each installation's high as two meters. In this installation technology and structure are split into three blocks: (1) web APP, (2) cloud server, program, and (3) LED data sculpture. The entire system consists of three blocks which are able to transmit information through a wireless network. A set of data transmission systems by IoT technology, which is able to implement a series of interactions and data transmission through mobile phones, cloud servers, and LED lights. In LED lights are totally 3 modes in the artwork which are respectively: “English learning mode”, “On-the-hour light art mode” and “Dynamic light art mode.”

In this installation technology, WebAPP uses users' mobile phones to open a web page. When the user opens a mobile phone to scan a QR-Code to get a web link and open it. The web link will open a web page, the installation will into English learning interactive mode, and the installation lights will switch to a colorful effect and be ready to play, as shown in Figure 3.



Figure 3: Uses users' mobile phones to scan a QR-Code to get a link and open to play.

In this WebApp program: The user needs to open the web page as a WebAPP to interact. Step 1: It is a web page by scanning the QR code with mobile phones, users may answer questions interactively to add up some score. So they need to select one of the colleges to



represent the user's college, as shown in Figure 4. Step 2: When users see the question on the web app, they need to click one of the questions to answer it. Step 3: According to the instructions, the user will generate the relevant data and effect for the English learning mode, as shown in Figure 4.

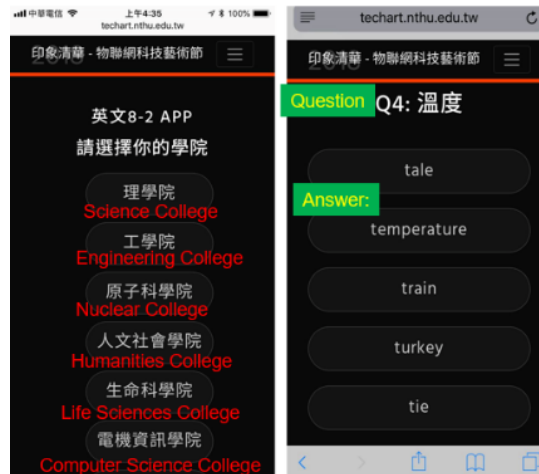


Figure 4: The first step is to select one of the colleges to represent (Left), and click one of the questions to answer (Right).

The Cloud Server Program: It is the cloud server program constructed by ourselves and it is used to receive and transmit real-time data from WebApp. The user interactive behavior and results of the English questions will be bi-directional communication between request and response in order to data going backstage. Cloud Server Program also designed to store these questions be as data in the database. Then, it constantly and synchronously uploads the English score to the LED data sculpture for updating the mode value.

In LED light pillars and data sculpture: When users complete answer the questions and trigger the LED effect. The Score will transform into the Data and show each college's total score. These colleges' scores will transform into 10 LED light pillars and represent each college in NTHU. Also, these LED light pillars as LED Data Sculpture are mainly used to receive the data from the Cloud Server Program and continuously update the data with the controller. If the relevant data is read, the lighting controller will be interactive results, and shown timely in three modes linked by lighting data sculpture. These modes depend on the Data and use the Cloud Server Program to compute the score's results. When the user's score Data is transformed and sent to the Cloud Server Program. In the transmission and computing of data: Firstly, participants are supposed to connect with the Web App of the mobile phone's network by scanning the QR code to get a unique URL address. In this way, when the participant gets a URL, the answer mode for English learning is initiated. Meanwhile, participants using the Web APP will communicate through the Web Socket and Apache Web Server to transmit and compute in the Cloud Server Program. In the next step, the data of all participants who deal with the English puzzle through the mobile network will be stored in the database with the web server. The data exchange by JSON File and the number of correct answers information from participants will be recorded. All of the exchange and stored data are real-time and bi-directional communication (MQTT Protocol), as shown in Figure 5.

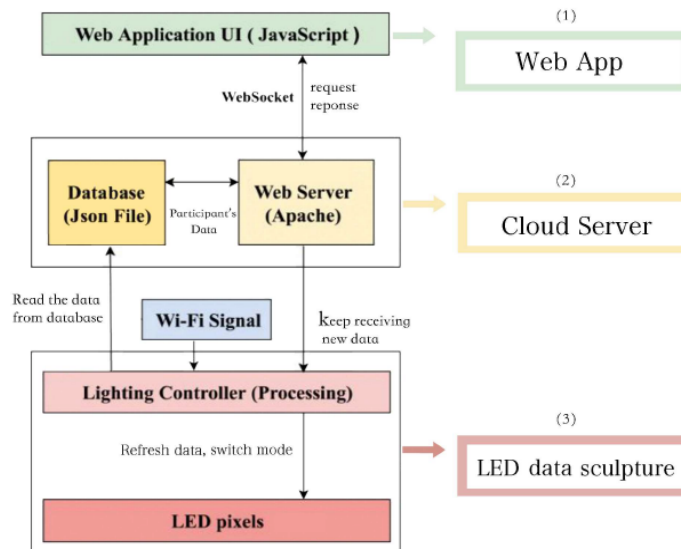


Figure 5: The network and transmitting design for the “English 8 minus 2” system.

When Web APP (1) and Cloud Server Program (2) are transmitting information and messages to each other, Cloud Server Program (2) and LED data sculpture (3) exchange data will be synchronously. The lighting controller is a PC computer and LED control board with part of control components, transformers, and wireless signal processing modules. The LED pixels can be controlled by the processing program. The program runs an effect application to control light artwork.

The above parts, It about technical and Data transform ways to run the “English 8 minus 2” installation. In the English learning mode design detail: We design two sets of question rules in the question database. One is the simple questions of the English examination for students in junior high school. The other is difficult questions from IELTS. The two sets of questions are randomly distributed for participants to answer. When users using a mobile phone scan the QR Code from the stand. Open the web app and select one of the colleges represented on the light pillar. In 60 seconds, the user needs to answer the right question. One right answer value will light up the LED light pillar in one yellow color unit. If the user collects a lot of the right answers, the system will add value for each light pillar. The answer score just like data will transform to each college and show different various colors, as shown in Figure 6.



Figure 6: The user collects a lot of the light answers, which will show different various colors.

In the On-the-hour light art mode. Every hour and system will detect no one playing this installation. The system will show the score value. One answer of scores for the specific college will be shown by the 10 light pillars. According to the time, when no participants interact for a period of time, this effect will run for about 5 minutes. That is very beautiful

and elegant for visual effects, and the LED color will be checked for participants engaged answering in every hour. In Dynamic light art mode: All 10 light pillars will be presented with dynamic white lights for the artistic light show.

## **Mass Learning Survey**

This artwork, we were built during the Tsing Hua Effects Festival in 2019 [8], and we did a survey in 2023 using video records to show and explain how to work for 31 participants. in 2019, at that time, we didn't have to design a survey and do research things. After the COVID-19 pandemic. We are afraid of the virus spreading, so we are doing research this year. In this research, we are designing a survey including two theories to find out whether participants using this work for mass learning is effective and motivation to stimulate English learning.

In the SDT theory proposed by Prof. Deci & Ryan. This theory focuses on an extrinsic/intrinsic motivational theory of personal, development, and social processes. Especially autonomous motivation and controlled motivation. Tiger's four Pleasure Theory focuses on evaluating how pleasurable a product will be used and owned. By Pleasure theory, we want to find out Light art mode for students physio-pleasure and psycho-pleasure. Also, the English learning mode for students is "socio-pleasure" and "ideo-pleasure."

In questionnaire design: We have designed 10 questions for participants to answer, as shown in the Appendix. These are 10 Questions from 1 to 10. All questions are in two theories on how to design and set up. For example Question 1. Would you find it interesting? Could the "English learning mode" in the artwork be a new form of public art? In this question, we design SDT theory to point out extrinsic motivation and in pleasure theory, we get socio-pleasure for a new form of public art in this installation. For other questions, in question 2, we design SDT theory to point out extrinsic motivation and pleasure theory, and we get physio-pleasure. In question 3, we design SDT theory to point out intrinsic motivation and pleasure theory, we get ideo-pleasure. In question 4. we focus on effect experience and inspire more feelings of effect representation. In question 5, we focus on this mobile the WebAPP where answering questions can earn points within the interaction installation and find out which Learning Mode is more interesting. In question 6, we focus on how to better embody the spirit of "interdisciplinary collaboration" and "teamwork?" In question 7, we focus on English scores and inspire the idea of wanting to start studying. In question 8, we focus on new knowledge, and new experiences, and find them refreshing. In question 9, we focus on new learning modes and more effective experiences.

Depends on the above questionnaire design. In SDT theory, we made a survey results. In terms of extrinsic motivation, over 93% believe that extrinsic can be stimulated. In terms of intrinsic motivation over 96% believe that intrinsic can be stimulated. By Pleasure theory, we also made survey results. Light art mode brought students physio-pleasure and psycho-pleasure. Doing English learning mode brought students "socio-pleasure" and "ideo-pleasure."

## **Conclusion**

In future works, This design may become a new type of "Mass Learning" or "Collective Learning", integrating cross-field knowledge and creative ideas into an imagination of the future. It can be used in advertising, creative learning teaching...etc. In Taiwan, we have also

used "English 8 minus 2" for university anniversary activities and applications for some special events. This public interactive taking such content as the objective of creation can be the pioneer for the combination of "Public Art" and "Mass Learning" in the future. It is the contribution of the research to expand the thickness and dimension of the development of mass learning in works of public interactive art. Will the students from the college who finally get the highest score in English studies be reduced from 2 credits? Unfortunately not. The school's Academic Affairs Office thought our idea was very good, but it requires a school meeting to make a decision. Anyway, our "English 8-2" public art learning has been a favorite and recognized by the school and students.

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## Appendix: Questionnaire Design

Questions	SDT Theory Design in Questionnaire	Pleasure Theory Design in Questionnaire
Q1: Would you find it <b>interesting</b> ? Could the “English learning mode” in the artwork be a <b>new form of public art</b> ?	SDT Extrinsic Motivation	Socio-Pleasure ( new form of public art )
Q2: Regarding the “English 8 minus 2” artwork, <b>the LED effects display the scores</b> for various colleges. <b>Does it inspire you to engage</b> in an “English learning mode” to improve your scores?	SDT Extrinsic Motivation	Physio-Pleasure ( LED effect display the scores )
Q3: Regarding the appearance and visual effects of the “English 8 minus 2” art installation, do you agree that the “art installation of certain data significance can as a <b>new mode of learning</b> ?”	SDT intrinsic Motivation	Ideo-Pleasure ( new mode of learning )
Q4 : "In the Light art mode," do you think that the <b>effect experience</b> of “English 8 minus 2” can <b>inspire more feeling of effect representation</b> to enhance the results of English learning?	SDT Extrinsic / intrinsic motivation	psycho-pleasure ( effect experience )
Q5 : Regarding the “English 8 minus 2” mobile Web APP where answering questions correctly <b>can earn points</b> within the interactive installation, do you find this <b>learning mode more interesting</b> ?	SDT Extrinsic / intrinsic motivation	physio-pleasure ( earn points )
Q6 : if you are a designer and implementing the “English 8 minus 2” interactive art installation, <b>do you think this artwork would better embody the spirit of “interdisciplinary collaboration” and “teamwork”?</b>	SDT intrinsic motivation SDT intrinsic Motivation	socio-pleasure ( interdisciplinary collaboration and teamwork )
Q7: Do you think it’s important to see students from other colleges inputting their <b>"English scores," and does this inspire the idea of wanting to start studying</b> English diligently?	SDT Extrinsic / intrinsic motivation	ideo-pleasure ( English scores and idea of wanting to start studying )
Q8: During the appreciation of the interactive installation artwork “English 8 minus 2,” did you <b>acquire new knowledge, and new experiences, and find it refreshing</b> ?	SDT Extrinsic motivation	psycho-pleasure ( new knowledge, new experiences )
Q9: Regarding the interactive installation artwork “English 8 minus 2,” do you want to know how to integrate <b>it into big data, new learning modes, more effective experiences, or situational atmospheres</b> ?	SDT Extrinsic motivation	physio-pleasure ( new learning modes, more effective experiences )
Q10 : Regarding the interactive installation artwork “English 8 minus 2,” do you have any suggestions?		

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