SMART ITALIC
MI.TO'S

-GUARINO GUARINI

SMART ITALIC MI.TO'S
Guarino Guarini

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Astratta

Questa tesi è sotto l'argomento SMART ITALIC MI.TO'S. A partire da un architetto eclettico Guarino Guarini, nato nel 17 ° secolo in Italia. Guarini non ha lavorato in isolamento, come Leonardo. Guarini ha lavorato su scala cosmica. Allo stesso tempo, come insegnante, si impegna a diffondere complesse conoscenze teoriche al pubblico attraverso l'imaging e altri modi.

Cercando la fonte di Italic, ricercando i suoi risultati per scoprire il punto italico di Guarini, il modo di pensare italico. Inoltre, analizzando il risultato attraverso il processo di scoperta. Usando il punto Italic come chiave per diffonderlo al suo pubblico potenziale, svegliali da questo progetto di design.

Sulla base di questo punto, l'estensione del progetto conclude 2 parti, la prima parte è collegata al processo di ricerca dello "scintillio". Dal punto italico di Guarini - Interdisciplinare, concluso dalla ricerca. Dando un'introduzione specifica ai suoi successi nel combinare diverse aree di conoscenza nel suo progetto di design. La seconda parte è la dichiarazione di concetto. La scelta di giovani creatori come utenti target e la realizzazione del progetto finale è un terminale di prodotto interattivo nello spazio creatore che integra insegnanti e giovani creatori. Usando la tecnologia dell'istruzione adattiva irregolare basata sull'IA. Secondo i dati AI in tempo reale, per esplorare come l'AI può essere utilizzato per assistere il processo di insegnamento.

Abstract

This thesis is under the topic SMART ITALIC MI.TO'S. Starting from an eclectic architect Guarino Guarini, who was born in 17th century in Italy. Guarini did not work in isolation field, like Leonardo. Guarini worked on a cosmic scale. At the same time, as a teacher, he is committed to spreading complex theoretical knowledge to the public through imaging and other ways.

By looking for the source of Italic, researching his achievements to discover the Italic point of Guarini, the Italic way of thinking. Furthermore, analyzing the result through the discovery process. Using the Italic point as a key to spread it to its potential audience, awake them by this design project.

Based on this point, project extension concludes 2 parts, first part is connected to the process of finding the "sparkle". From the Italic point of Guarini – Interdisciplinary, concluded from the research. Giving specific introduction to his achievements of combining different area of knowledge together in his design project. Second part is the concept statement. Choosing young maker as target users and come out the final project is an interactive product terminal in the maker space that integrates teachers and young makers. By using the technology of irregular adaptive education based on the AI. According to the real time AI data, to explore how AI can be used to assist teaching process.

Frank Lloyd Wright.plan of the steel cathedral (New York,1972,project)

1. Theme Intro

The final synthesis laboratory investigates the universes of interest that are most interesting for those dealing with Made in Italy: Italians are Italian citizens in Italy and outside Italy, descendants of Italians or a global community estimated around 250 million people in the world, to whom globalization gives new meanings and potential.

1. 1 Italic
1.1.1 MI -To

A people to some extent post-national, marked by identity, memberships and citizenship declined in the plural. Characterized by hybridization of cultures, products, ways and means of production that we call "italics" who assert themselves and seduce by the imaginary they convey : becoming aware of the existence of the "common system of values" in Italy, it means in fact starting to use it as a factor of promotion and business. Becoming storytelling carriers, turn into tools to create new stories and generate unexpected relationships.

In particular, the experience of tourism and the relationship between Italians and Italy will be the track (focusing on the MI.TO area between Milan and Turin, between Lombradia and Piedmont) in which to imagine possible routes and narrations, where objects and their packaging through IoT technology will become storytelling carriers, turn into tools to create new stories and generate unexpected relationships.
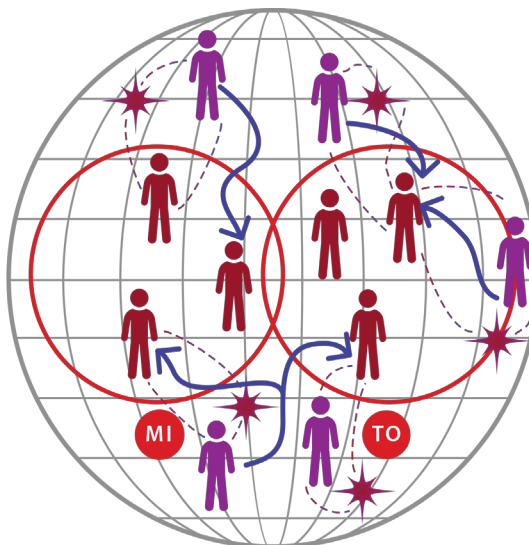
SMART ITALIC MI.TO'S
Relations, interactions and objects for new Italic paths between Lombardy (MI) and Piedmont (TO)

Steps of finding the Italic
In the past:

1.Track

Looking for the source of Italic, through the main research objects to discover his points about Italian characteristics. Understanding the main achievements of the research subjects and the background of the times. Furthermore, analyzing them through the following parts:

1. Where they have been, places related to the researchers.
2. Events, through important historical events or meetings with important people to analyze the impact on the ideological level of the research object.
3.Project, to understand his design philosophy and personal characteristics by understanding the work of the research object.
4.Honor, the honors received represent a broad evaluation of the subjects at that time.
5.Publications, the publication of the research object is the best and most direct record of his ideas and can be closest to his heart.

6. Family and friends, who are the most frequently contacted by the research subjects, who will influence the research subjects at different stages, especially the influence of family members in the childhood of the study will further affect his life planning.
7.Meet and meet with some important people, especially those related to his research field.

Integrate the above seven key points to thoroughly analyze the research objects and make the characters three-dimensional. From the cold record of the survey data, a vivid character image is created, which is more like a familiar friend. The timeline of the character is summarized and covers all aspects of the information. The next section will show you the timeline for Guarino Guarini to see this talent people's whole life path.

PAST   **FUTURE**

| 1. TRACK | 2. AWARE | 3. TRAVEL |

Italico "Sorgente"

Italico "Risvegliato"

Sparkle

Trip to Italy

2.Aware

Italic reawakened, summarizing the Italic points of the five subjects through the timeline, focusing on the analysis and weighing the importance between them. Then choose the one that best represents Italy. It needs to be clear and easy to understand, and it is a unique point of Italy and has been widely recognized. In the later stage, as a starting point of the design, around this point, the design of this Italic point is more effectively transmitted.

After finding the most intensive Italic point, by deducing the specific project plan with a few points, the whole project has a clear outline and provides a framework for the third step of Travel to achieve the desired results. The analysis framework is divided into What Who When WHere and How. These five parts are the second step of Aware's basic framework to clarify the next design ideas.

First of all, we must define what is representative of Italy in this project. It needs to be the first step: what. Next, find out the potential audience, what is the audience? That is, this type of person is a potential influencer of Italic. They live outside of Italy but have inextricably linked with Italy. Their family may have lived in Italy or studied in Italy. They have been affected by this Italic but have not realized that needed to re-awake through this project and let them realize that they are affected by Italic. This is Who. Find relevant places and scenarios to awaken potential users, such as analyzing the audience's

behaviors and habits, and then designing the corresponding scenes based on the results. This is When and Where.

Finally, since this project is designed for 2025, after clearing the theme, it will find and develop the technology with the development trend and potential through research and analysis. These technologies should be forward-looking and can be existing. However, the technology is not mature enough to have a strong development momentum, but it can also be a breakthrough development in some areas and propose potential development in other fields. The above content will be introduced and analyzed in detail later in Thesis.

Interactive Nike Windows for Selfridges (London, during Olympics)

Photo- Thanassi Karageorgiou

1.2 Guarino Guarini

1.2.1 Historical evaluation

Image: archive.org / public domain

Guarino Guarini C.R., (1624-1683)

Camillo Guarino Guarini (Modena, 17 January 1624 - Milan, 6 March 1683) was an architect and theorist of Italian architecture, as well as a writer and author of works of mathematics and philosophy.

Trained in Rome, with the example of Francesco Borromini, Guarini was particularly active in the city of Turin, where he became one of the leading exponents of the Piedmontese Baroque; among its main achievements are the Chapel of the Holy Shroud in the Duomo, the Carignano Palace and the church of San Lorenzo.

"

CHARLES SAUMAREZ SMITHI:
"I have been trying to get to grips with the history of Piedmontese architecture as background to visiting the buildings. Key to understanding it is obviously the career of Guarini, trained as a Theatine monk and the most intellectual of architects, equalled perhaps only by Wren, who was his nearly exact contemporary (Guarini was born in 1624, Wren in 1632; both visited and were influenced by Parisian architecture in the 1660s)."

"

Roberto Masiero, David Zannoner - Italian Contribution to the History of Thought - Technique (2013):
Guarino Guarini (1624-1683) inaugurates a new season in the art of building domes: the innovations that he introduces do not involve only the architectural sphere, but also aspects of a structural and constructive nature. The new idea is to isolate, in the turn of rotation, some structural components, opening the rest of the surface, so as to let you penetrate the light of the Sun. As we have seen, Alberti had already defined the structural concept of the dome as a set of multiple arcs, arranged in all directions: he had marked the characteristics of an arrangement that today we will define as hyperstatic. Starting from this set-up, the opening of the system can then take place by identifying a particular set of arcs, among the possible infinites, on condition of selecting a stable configuration, and obtaining the openings within the complementary geometry.

"

Jarnes P. McQuillan:
"Is now recognised as one of the great architects of the High Baroque. Author of imposing works on natural philosophy, mathematics and astronomy, plus a posthumous architectural 'trattato', the nature of his thought and its relation to his architecture is still unresolved." (Jarnes P. McQuillan ,Geometry and light in the architecture of Guarino Guarini,June 1991,University of Cambridge)

"

Roberta Spallone:
During his stay in Turin as an architect and engineer at the Savoy court, Guarini addresses the issue of fortifications. In those years, in fact, he also works in the field of military buildings, despite being predominantly engaged, both on theoretical and practical ambit, in civil and religious architecture. Dates back to the 1676, the publication of the Trattato di Fortifica-tione, one of his lesser known works, while his design for the 'Gate of Po' is realized since 1674.
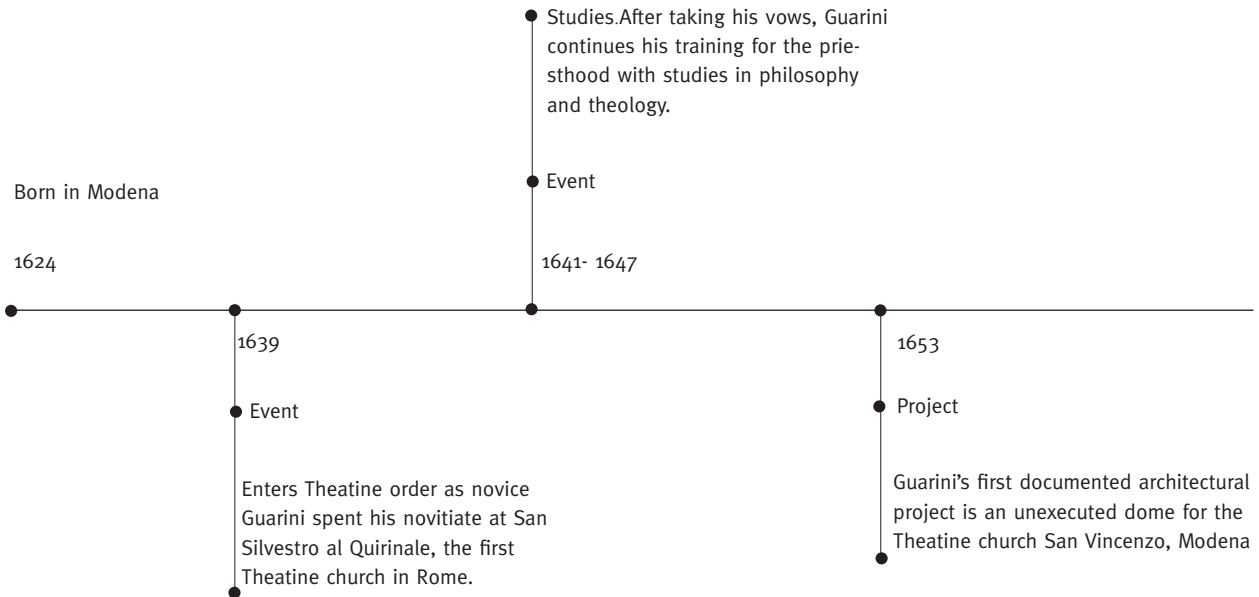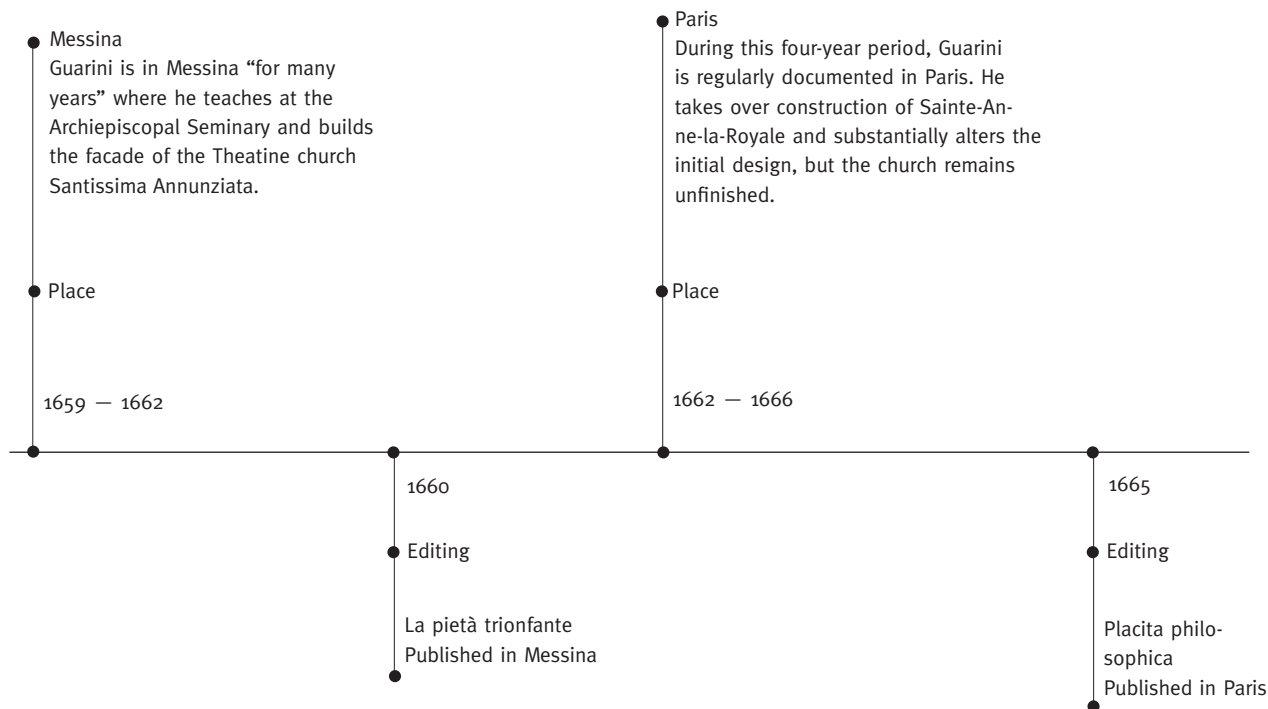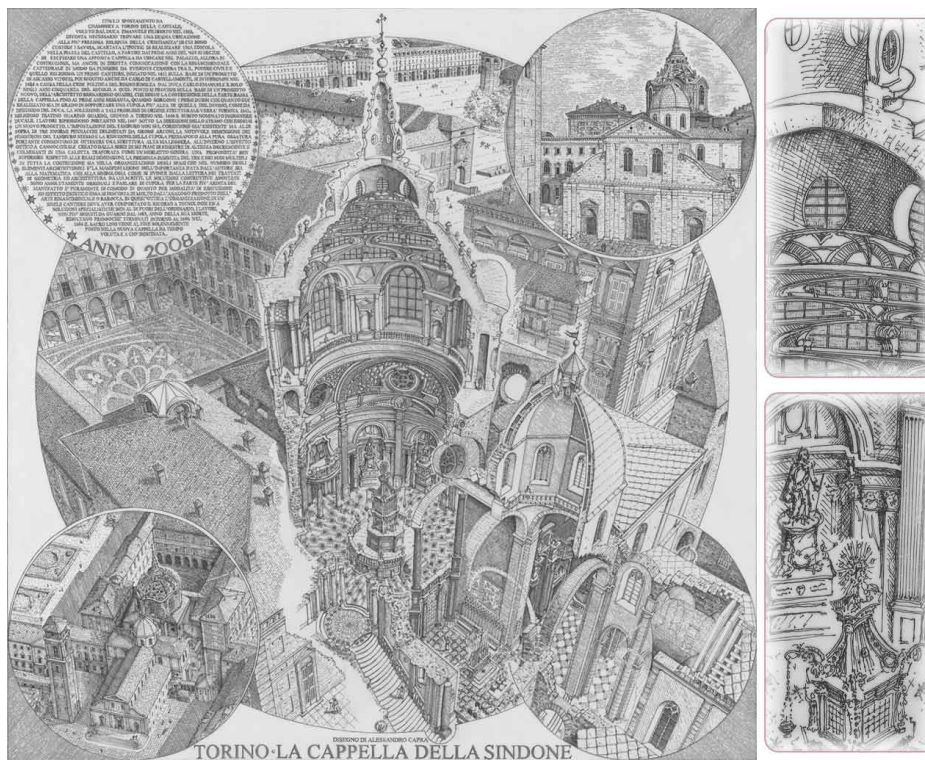
1.2 Guarino Guarini
1.2.2 Timeline

1624 — 1683
Guarino Guarini Timeline
A documented overview of the life and work
of the Theatine priest, scholar, and architect

Studies.After taking his vows, Guarini
continues his training for the prie-
sthood with studies in philosophy
and theology.

Event

Born in Modena

1624

1641- 1647

1639

Event

Enters Theatine order as novice
Guarini spent his novitiate at San
Silvestro al Quirinale, the first
Theatine church in Rome.

1653

Project

Guarini's first documented architectural
project is an unexecuted dome for the
Theatine church San Vincenzo, Modena

Messina
Guarini is in Messina "for many years" where he teaches at the Archiepiscopal Seminary and builds the facade of the Theatine church Santissima Annunziata.

Place

1659 — 1662

1660

Editing

La pietà trionfante
Published in Messina

Paris
During this four-year period, Guarini is regularly documented in Paris. He takes over construction of Sainte-Anne-la-Royale and substantially alters the initial design, but the church remains unfinished.

Place

1662 — 1666

1665

Editing

Placita philosophica
Published in Paris

By Alessandro Capra

1667 — 1694

Chapel of the Holy Shroud, Turin
The chapel, begun c. 1610, was com-
pleted to the first cornice when Guarini
arrived in Turin.
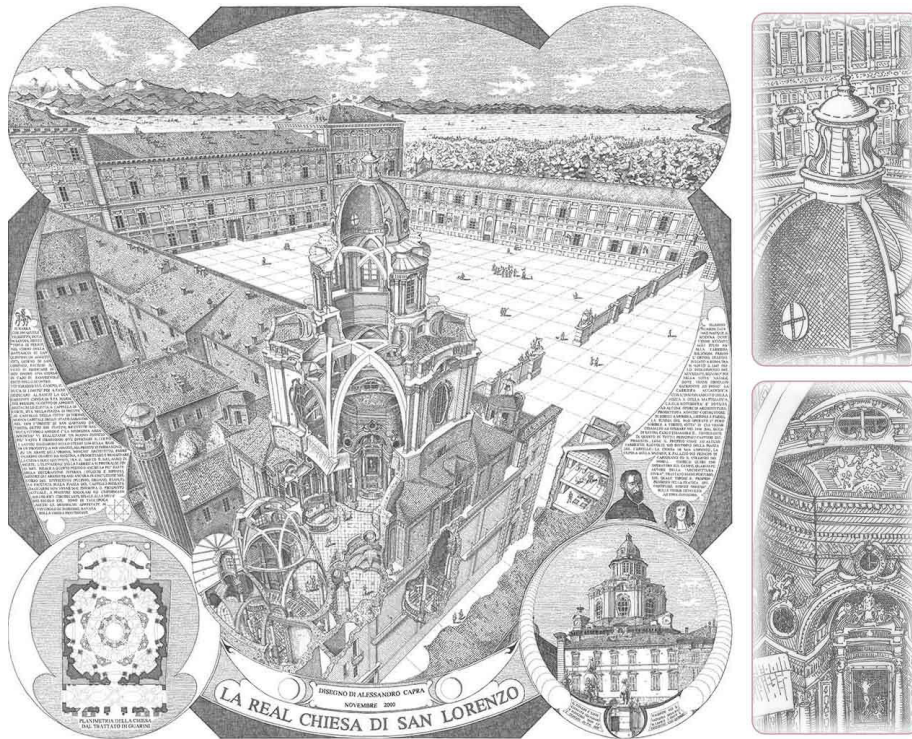
By Alessandro Capra

1670 — 1680

Construction of San Lorenzo, Turin.The construction accounts for Guarini's building campaign at the Theatine church of San Lorenzo, Turin, begin in January 1670. Major construction concluded on 27 October 1679, and Guarini celebrated the inaugural mass in the church on 12 May 1680.

Guarini was in Rome during 1639–47, when Francesco Borromini was most active. Later he taught in Modena, Messina, and Paris and finally in 1666 went to Turin, where he stayed for the greater part of the remainder of his life. While in Turin in the service of the dukes of Savoy, Guarini built (or furnished designs for) at least six churches and chapels, five palaces, and a city gate; published six books, two on architecture and four on mathematics and astronomy; and sent palace designs to the duke of Bavaria and the margrave of Baden.(The Editors of Encyclopaedia Britannica,Guarino Guarini)

Euclides Adauctus
Published in Turin

Editing

1671

1674

Editing

Modo di misurare le fabriche
Published in Turin

Compendio della sfera celeste
Published in Turin

Editing

1675

1676

Editing

Trattato di fortificatione
Published in Turin

Leges Temporum
Published in Turin

Editing

1678

Guarini Travels

Guarini Heredity
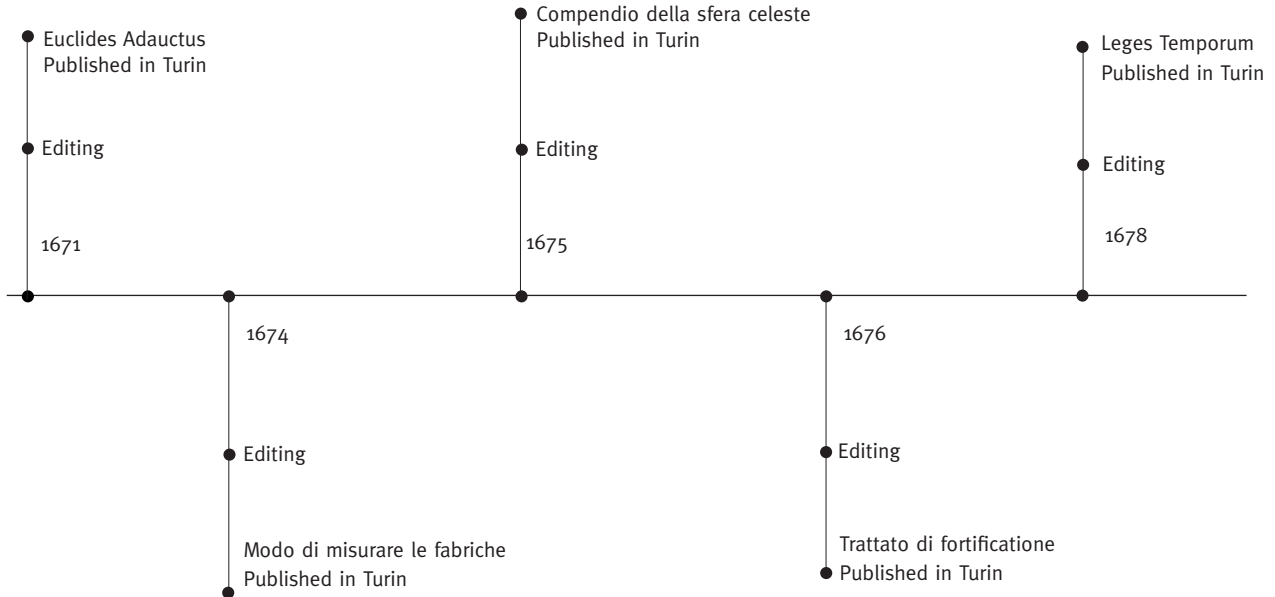
1737

Editing

Published in Turin, edited by
Bernardo Antonio Vittone

Kepler, "Harmonic Figure." From his Harmonices mundi.

2.Italic of Guarino Guarini :Interdisciplinary

With regard Guarino Guarini as the main research object, by analyzing his main works and the life time axis, he further describes the thoughts of the research objects and the representative features of Italy. Some representative points are outstanding, which are:

1. The ancient Roman architectural style, influenced by Roman and Early Christian. It was influenced by a multitude of geographic, climatic, political, economic, social and cultural factors. Guarini spent his student days in Rome, and his masterpiece also embodies the respect of the Romanesque dome.

2. Religiously related, since Guarino is a clergyman, his entire career has been centered around religious construction, and all projects have been implemented for religious purposes. As a member of the Theatine order, he received knowledge in all aspects of mathematical astronomy and theology at the student level, which was reflected in his architectural works.

3. Interdisciplinary, as mentioned earlier, Guarini has accepted a diverse knowledge education. Although he serves religion, his era is upright in religious reform. Religion hopes to spread religious thought through knowledge and art, so the clergy need to accept each in the field of knowledge such as mathematical physics astronomy, Guarini is a representative figure. His life published many books on architectural mathematics and astronomy. Interdisciplinary talents are also very representative features of Italy in the last century, like Leonardo Da Vinci, are knowledgeable in many fields.

Interdisciplinary as Guarini's Italic, in the following chapters, will detail how he can combine the knowledge of multiple fields to create.

2.1 Conclusion of Italic points of Guarino Guarini

2..1.2 Extensive interdisciplinary

Interdisciplinarity or interdisciplinary studies involves the combining of two or more academic disciplines into one activity (e.g., a research project). It draws knowledge from several other fields like sociology, anthropology, psychology, economics etc. It is about creating something by thinking across boundaries. It is related to an interdiscipline or an interdisciplinary field, which is an organizational unit that crosses traditional boundaries between academic disciplines or schools of thought, as new needs and professions emerge. Large engineering teams are usually interdisciplinary, as a power station or mobile phone or other project requires the melding of several specialties. However, the term "interdisciplinary" is sometimes confined to academic settings.

The term interdisciplinary is applied within education and training pedagogies to describe studies that use methods and insights of several established disciplines or traditional fields of study. Interdisciplinarity involves researchers, students, and teachers in the goals of connecting and integrating several academic schools of thought, professions, or technologies—along with their specific perspectives—in the pursuit of a common task.

Interdisciplinary may be applied where the subject is felt to have been neglected or even misrepresented in the traditional disciplinary structure of research institutions, for example, women's studies or ethnic area studies. Interdisciplinarity can likewise be applied to complex subjects that can only be understood by combining the perspectives of two or more fields.

Solithromycin
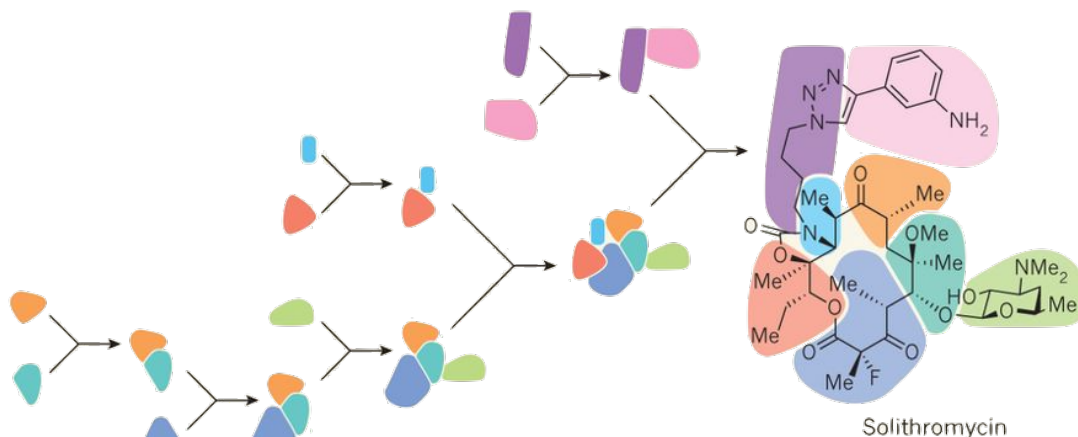
By:Fighting evolution with chemical synthesis

Although "interdisciplinary" and "interdisciplinarity" are frequent-
ly viewed as twentieth century terms, the concept has historical
antecedents, most notably Greek philosophy. Julie Thompson
Klein attests that "the roots of the concepts lie in a number of
ideas that resonate through modern discourse—the ideas of a
unified science, general knowledge, synthesis and the integra-
tion of knowledge", while Giles Gunn says that Greek historians
and dramatists took elements from other realms of knowledge
(such as medicine or philosophy) to further understand their
own material. The building of Roman roads required men who
understood surveying, material science, logistics and several
other disciplines. Any broadminded humanist project involves
interdisciplinarity, and history shows a crowd of cases, as se-
venteenth-century Leibniz's task to create a system of universal

justice, which required linguistics, economics, management,
ethics, law philosophy, politics, and even sinology.

2.2 Interdisciplinary project of Guarino Guarini

Because Guarini's achievements are concentrated in the 17th century, some of his works have not been translated into English and involve in many fields. The following contents are mainly based on the summary of the research results of relevant scholars and the simple popular science, with the intention to extract Guarini's design thinking mode and explore his social environment to find out the external factors affecting his design concept.

This chapter starts with the characteristics of the baroque period, because Guarini is one of the representative architects of the baroque period, active in Turin. Guarini was adept at most applications of advanced curvature and projective techniques. Guarini was proficient in the French tradition of stone cutting using most difficult procedures, as well as gnomonics, or the study of sundials, devoting many published pages to each discipline.

2.2 Interdisciplinary project of Guarino Guarini

2.2.1 Architecture and geometry in the age of the baroque

Since Pythagoras and Vitruvius, it has been believed that there is a law to beauty which exists objectively. Alberti also said that the various parts of the building "should undoubtedly be governed by certain rules of art and proportion." (volume VI, section 2) These rules are the harmony of geometry and Numbers. And these rules exist throughout the universe. Renaissance theorists also believed that the world was unified and that there was universal harmony in everything. Cologne argues that buildings should not only be self - contained but should also be part of the harmony of the whole world, subject to the whole world. They believe that the inherent law of architectural beauty is consistent with the law governing the world. That's the law of Numbers.

The main features of baroque architecture are: 1. Showing off wealth. Extensive use of valuable materials, full of decoration and bright colors. 2. In pursuit of novelty, architects are unconventional, with endless images and methods of architecture that have never been seen before. The main ways of innovation are: first, to give the building entity and space dynamic, or twists and turns, or riots and conflicts; Secondly, break the boundaries of architecture, sculpture and painting, so that they penetrate each other; Third, it disregards the rule logic, USES the irrational combination, obtains the abnormal illusion effect. 3. Go natural. Some open squares were built in the city. 4. Cities and buildings often have a solemn, vigorous, yet joyous air.
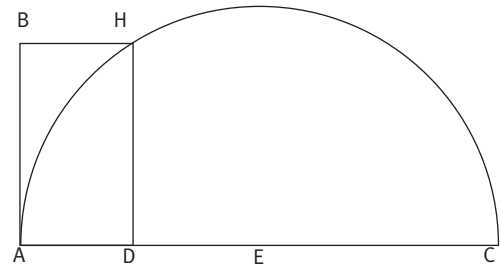
Fig.2.2.1.1 Guarino Guarini's scheme for deriving twogolden section rectangles from a semicircle. From Guarini,Architettura civille(1737)

After the 1630s, a large number of small parish churches were built. Because of its small size, the Latin cross is not suitable. So, it was centralized, but the Trent council said, "Catholicism cannot be square or round, that's the pagan form of architecture." Therefore, the new church has a circle, an oval, a hexagonal star, a cruciform, a quincunx, and so on. They often play with curves, curved surfaces and flow in space like waves. It is difficult to accurately grasp their images. These basic elements can be seen in Guarini's architectural works. It is worth mentioning that because of Guarini's achievements in mathematics, he always devotes himself to drawing with rules and regulations. And the text form of several mathematical definite reasons is improved to geometric figures for easy understanding.

James McQuillan said "Guarini was an important mathematician in the development of calculus, and his fame is not just that of an architect, perhaps the most learned that Europe has ever thrown up." George L. Hersey gave such a point that" Though few modern scholars make use of the fact, or even seem to realize it. Baroque architecture was above all mathematical. It comes from an age when architects and patrons could think of building as "studies in practical mathematics," to use Virgilio Spada's phrase about a proposed Pamphiljvilla in Rome. Any member of the major architects of the period were as much mathematicians as architects, and this when all of architecture itself could well have been called a subset of geometry. In this same spirit the preface to Guarino Guarini's posthumous "Architettura Civile" says that the book shows how "excellent a geometer Father Guarini was, how versed and profound in all parts of mathematics, and especially the part that constitutes civil architecture."

In the age-old connections between art and mathematics - however either is defined - no one is more worthy of attention than the Italian Baroque figure of Guarino Guarini. Trained as a theologian in the small but elite order of Counter-Reformation. In Guarini's first work of a philosophical-scientific nature, Placita Philosophica, published in Paris in 1655, he upholds the

importance of the knowledge of mathematics for all artists and scholars: "All the arts depend on either mathematics, philosophy or medicine, all sciences that examine similitude, proportion or the fittingness of things... Thus, the more profound the artist's knowledge is regarding the things relative to his art, of the means and manners of applying them, the more excellent will be judged, and the more perfect his works will be considered. In fact, when the artist sets himself to his task, he does well to choose the most suitable material, to have a perfect knowledge of his instruments, and the ties with all the things relative to the art, and finally to eliminate the devices used to create each thing. And since in the most difficult situations neither imagination nor intellect is sufficient, the devices drawn from these models can be applied most perfectly to the idea to be demonstrated and performed in that particular circumstance.

Guarini was adept at most applications of advanced curvature and projective techniques. The encyclopedia nature of his intended publications was achieved to the extent that in Microcosmic Mathematics, he published "Trattato di Fortificatione" and "Modo di mesurar le fabriche", prompted by courtly and building concerns, and of course leaving the manuscript of "Architettura Civile".

People in the age of Galileo, Kepler, Newton,and Kircher belie-ved that light moved and functioned much like sound. Armillary spheres (armilla=bracelet, hoot) have been known and used sin-ce antiquity. They take the form of round, overlapping concen-tric rings, each at a set angle. The rings are often marked with degrees(usually music geometric intervals such as diapasons, diapentes, and the like) The spheres display the great circles of the heavens including their equators, ecliptics(the path of the Sun around Earth or, alternatively, Earth's path as seen from the Sun), the tropics of Capricorn and Cancer, and the meridians of longitude. They show Earth's poles and polar circles.

In their ways, armillary spheres also analyze light: They represent (albeit in a stylized manner) the unseen geometric framework, and the motions, through that framework, of the universe's many luminous bodied. Almillary spheres demonstrate the tracks along which these glowing globes travel, interweave, approach each other, and withdraw(fig.2.2.1.2)

And these forms and ideas are reflected, or projected, in Baro-que architecture. One example is Guarino Guarini's dome of San Lorenzo, Turin (1668-80; fig.2.2.1.3). "Not that both the armillary sphere in fig.2.2.1.2 and Guarini's dome consist of continuously rotated armatures creating a stack of arcs, ribs that are seg-ments of rings or arillate." Elwin C.Robison(6). In other words, looking up into Guarini's dome we are being put, as it were, inside an armillary sphere.
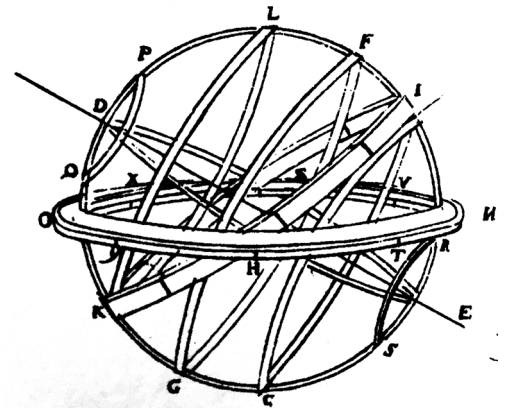
Fig 2.2.1.2 Guarino Guarini, an armillaru sphere. From his Architettura Civile,1686

Fig 2.2.1.3 Photograph courtesy of Erich Lessing/Art Resource,- New York.

Note, too, that Guarini uses his armillary setup as a lattice through which to project light. The sun moves around the windowed drum and the windows map the dome interior with their moving beams. If we think of this interior as a set of tropics, poles, equators, and ecliptics, as a skeleton spheroid whose ribs are the orbits of light -sources, then Guarini's dome, despite the absence of a painted scene of Heaven and its dwellers, is a heavenly image.

In the age of Baroque, number, music, and light were more tightly interwoven than nowadays. "In a way, if the late-eighteenth-century "revolutionary" architects with their massive masonry Platonic solids seemed genuinely new, earlier architects of the Establishment such as Wren, Hardouin-Mansart, and Soufflot seemed equally, if differently, so all the faces on a Platonic must be the same size and shape. But there are other solids, equally symmetrical, that mix different kinds of faces. Kepler addresses these when, in the Harmonices mundi, he speaks of more kinds of faces, though all of them must be same-size regular polygons such as squares, equilateral triangles, pentagons, and the like. In other words, the angles of each face on an Archimedean solid are uniform. On the other hand, rhombic solids have some faces that are diamond shaped-rhombs and with these, of course every angle is not the same. " Said by George L. Hersey(4), a professor emeritus of the history of art at Yale University. In his hook "Architecture and geometry in the age of the baroque "Chapter four named Cubices Rationes.

George L. Hersey also mentioned that Rhombic and Archimedean patterns of just these types, and variant forms of them, frequently appear in the coffers and ribs of Baroque domes. Guarini's dome at San Lorenzo, Turin (1668-80; fig 2.2.1.4), is a set of repeated tiled geometric faces formed into a sphere segment. The faces are equilateral triangles (around the lower windows), elongated pentagons (rising to the upper level of windows), tiny triangles formed by the superimposed ribs, and 45-degree-rotated squares that create a central octagon. So, of the forms we have discussed, Guarini's dome relates most strongly to the rhombic solids.
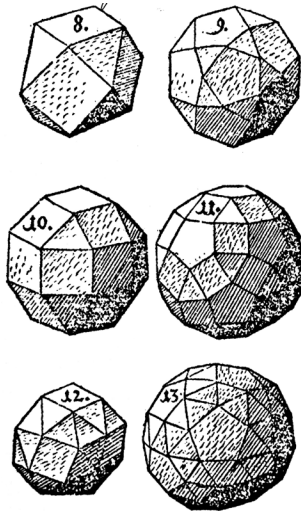
Fig 2.2.1.4a Kepler Archime-dean solids.From Harmonices mundi.

More simply, one can also see the dome as a circle, as shown in red in figure（2.2.1.5）, inscribed around a stellate octagon and, inscribed inside the inner points of that octagon, in brown, and another octagon, but with plane sides, in green. In either case we have the upper hemisphere of a triakid hexagon-a 36-sided figure made up of two slightly different triangles. There is also an octagon on the top and(in the complete sphere of which this dome is a segment) on the bottom and in the center of each side. A dome like this could only be the work of someone, like Guarini, who had studied rhombic solids.

Fig 2.2.1.4 Courtesy Yale University Art and Archi-tecture Library,Photograph Collection.
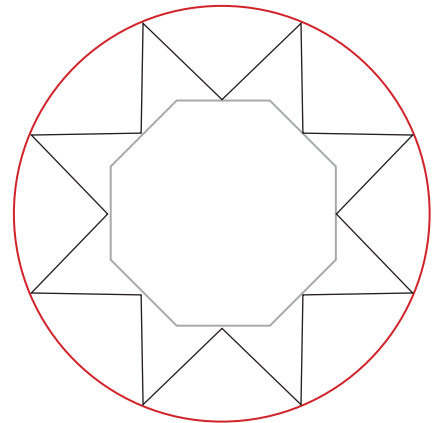
Fig 2.2.1.5Guarini' San Lorenzo dome dia-grammed as half of an Archimedean solid.

"The faces of the solids we have looked at tile into spheroidal shapes. But the same forms can be regarded as flat planes, especially since, when printed on a page, that is literally what they are. Which also happens in the plans of buildings. Such plans can make use of the faces of Archimedean and rhombic solids."said George L. Hersey(4)(Fig 2.2.1.6) depict three phases of the Solomonic shaft, now to be regarded as a model of geometrical Saulen philosophie. The three images are taken from Guarino Guarini's 1686 treatise on civil architecture. On the far left the twisting process has not yet begun. The left-hand shaft is the starting-point, ground zero, with intact vertical flutes. Then comes the first phase of twisting. The vertical flutes

are tightly screwed into nested right-hand helices. In phase three the hyper whorls develop.

Guarino Guarini has a plate showing (among other things) how to calculate the area of a circle without using the value of pi £¨the area of a circle=ϖr2) He does this because pi is an irrational and therefore, if you are a Baroque architect, you avoid it where possible. In Guarini's solution the circle's whole area is filled with as many different sized triangles as will fit inside it (in his illustration, figure 2.2.1.7, he has begun but not completed this process). The area of these triangles can be calculated by using rational or effable ratios. The total area of all these triangles will roughly equal that of the circle. (7) "In mathematics this is called the "method of exhaustion." And it is still used as a way of calculating the area of shapes with problematic perimeters "said Keith Devlin(8)

Fig 2.2.1.6 Left to right: shaft with straight flutes; shaft with weisted flutes;shaft with weisted flutes and hyperwhorls.From Guarini,Architetture.
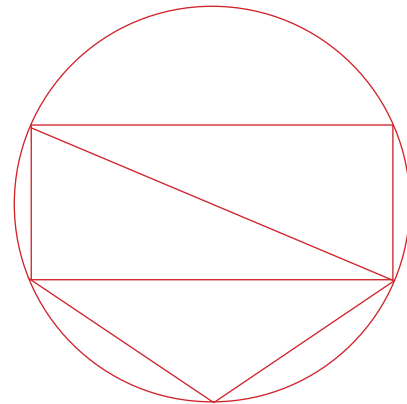
Fig 2.2.1.7From Guarini.Architetura Civile.

2.2 Interdisciplinary project of Guarino Guarini

2.2.2 The secret of the universe is hidden in the church

While Guarino Guarini is well known as an architect, his intellectual work was not limited to architecture, and three of his publications concern astronomy. This present paper concentrates on the first part of the 1683 Coelestis mathematicae. It appears clear that Guarini refused to take any official position in defense of either heliocentricity or geocentricism." said Sylvie Duvernoy(9) in his published work about Guarino Guarini.

Guarino Guarini is well known as an architect and many of his achievements, among the most beautiful adorn the city of Turin. Yet the intellectual work of Guarini, is not limited to architecture, three publications relating to astronomy. The first of these works brings together his courses in physics and philosophy.

The history of science is too often content with a few key dates for to punctuate the history of cosmology. It seems then that in 1632 everything was said and that the interest of a text published in 1683 seems therefore minimal. By doing this that the Catholic religious, including Guarino Guarini was part of it since it belonged to the order of the Theatines, and which constitute a great part of the intellectual elite, are muzzled by the inclusion in the Index of the Copernican 1616. Protestants also encounter difficulties in defending Copernicus. He must be

careful about the opinions published by the authors and not take for cash the fact that one or the other seems to defend the system of Ptolemy. Often their secret opinion does not appear in the publications.

Guarini's emphasis on measures, an importance that had already been shown by the numerous tables to which he devotes several works. The fact of staying close to the measurements automatically leads to a Ptolemaic pace because we do not forget up to our space probes, all measurements have always been geocentric.

In the fifteenth treaty, Guarini points out that the lower planets have as the one of the phases. He illustrated this statement with a drawing of a rotating moon around the Earth and a planet revolving around the Sun. It shows both phase phenomena and the fact that the planet alternately passes in front of and behind the Sun while the Moon is still below it.(Fig 2.2.2.2)

Guarini summarizes here the whole story of the discovery of the form of Saturn. Initiated by Galileo, who believed in the presence of three contiguous stars, was recomposed by Riccioli who brings together in its Novum Almagestum all the forms that

have been proposed for Saturn. It's finally Huygens who will explain his shape surrounded by a ring in De systema saturnium [1659] (Fig. 2.2.2.3).

The access to the Chapel of the Shroud was elaborated starting from unstable elements, contrasting with each other, able to satisfy a high public and not inclined to popular devotion. The three regular entrances, at 120 ° angles, left the privileged role to the Princes, who entered directly from the new wing of the Palace, and at the same time indicated to the pilgrims that crowded the church a one-way path that did not interfere with the functions of the Duomo.(Fig.2.2.2.2.7)

Fig. 2.2.2.1. Pages 454-455 extraites du Coelestis mathematicae publié par Guarino Guarini en 1683

It was forced to rotate around the case in the two clockwise and anticlockwise directions (fig.2.2.2.8), according to a concept that privileged the historical time, the limit of a short season where every being, even high, lost its life.

Still with this theme or transformation and metamorphosis, we come to minor symbolism in the Sindone, beginning with the 'deformed hearts.

According to the description from Sylvie Duvernoy(9),"The heart, Aristotelian seat of the soul and popular mediaeval symbol of the Passion (the Five Wounds), is found in the Upper Dome of the Blaeu Engraved Section. They occur as crowned hearts in the lowest range of decor at the springing of the Upper Dome. A fragrament from the Church of the Annunziata, Messina, is illustrated by Franco Borsi. In an oval frame a winged heart bears a flame, and radiates an aureole. In both instances they are perfectly formed, and thus signify the Sacred Heart, which was then blossoming as a cult, still observed. These are deformed hearts in the context of the theme of transformation introduced above. Guarini is careful to allow only the most particular of human forms to be deformed within the Sindone, and while it well portrays the anguish of human existence, it must also be read as the sufferings of Christ on His way up Calvary. As the hearts in the Stairs invite touching, they present the pilgrim a tactile experience in this shrine, where the object of devotion, the Shroud, is always concealed like the heart, except on the rarest occasions."(9) Centuries developed into the trigonometrical tables that we use today.

These constructions anticipate the boundary of the upper heavens immediately beneath the Dome of the Intelligible World. Again, the pentagrams may represent the fifth element-aether, the fire of the Empyrean or for Guarini, the perfect light in a perfect diaphaneity. Secondly, the pentagram contains the
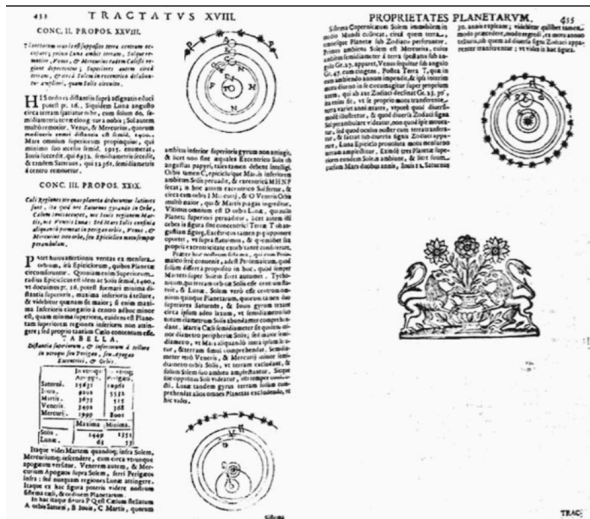
golden section in its construction, so it may signify the only proportion allowable in the intellect's ascent to God. Both the pentagram and hexagon are gnomonic numbers, so both are emblematic of projection and emanation.
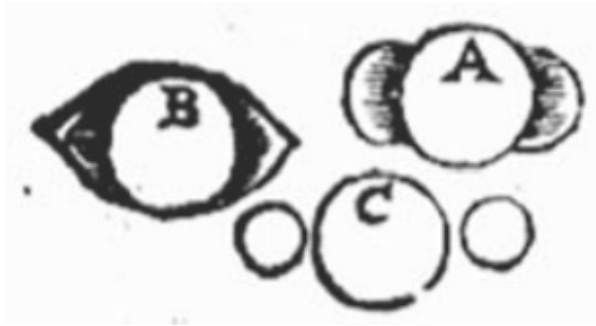
For almost thirty years, the Turinese, looking up at Palazzo Reale, saw the dome of Guarini wrapped in sheets and wrapped in scaffolding. Its reopening is not just a big city festival, but an unmissable opportunity for the world to admire a pearl of the Baroque.
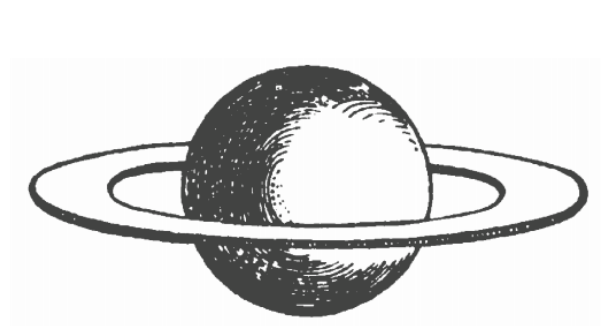

Fig. 2.2.2.2 Saturn representations proposed by Guarini, we recognize the triple star of Galileo in C the handles proposed by Fontana and Riccioli in A and a bizarre shape in B that could also correspond to a proposal by Fontana

Fig. 2.2.2.3 Representation of Saturn by Christiaan Huygens

The light that penetrates from the star to the top of the dome slips to the black marble floor studded with bronze stars. The choice of the dark coating arises from the desire to avoid bright reflections that would divert attention from the precious central altar, custodian of the Holy Cloth.(pic.Stars inside) The preciousness of the chapel is further enriched by numerous symbolic references: stars and hexagons represent the empyrean, the crosses are symbols of redemption, while the Passion of Christ lives again in the thorns and in the olive leaves.

Fig 2.2.2.4 Representations of the phases of Mercury and Venus as shown by the telescope according to Guarini
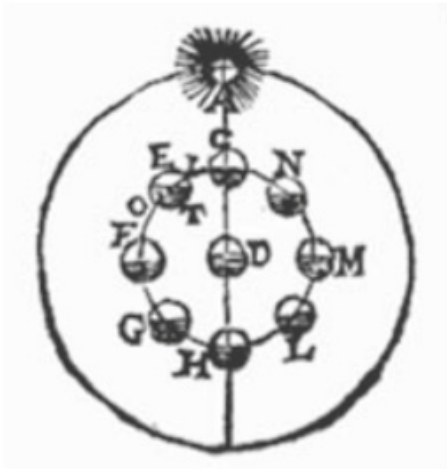
Fig. 2.2.2.5 Phases of the Moon explained by Guarini

Expense II of illuminatione Planetarum(Expensio II of the illumination des Planètes)Theor. I. Propos. VII. : Lunae suum a sole lumen mutuatus, & hinc various phasibus variator
(Theor. I. Prop. VII.: The moon is reçoit sa lumière du Soleil et elle a from variable phases) (Figure 2.2.2.5) Theor. IV. Propos. X.: Planetae superiors containers lumen to Sole, neque corniculata, nex bifidi cerni queunt; thirst tantum gibi [Coelestis mathematicae, Vol. 1, p. 444].(Theor. IV. Propos. X.: Les Planes supérieures réçoivent leur lumière du Soleil but ne sont jamais in croissant, or in demi, but parfois gibbeuse.) (fig 2.2.2.6)(Sylvie Duvernoy, Nexus Network Journal:architecture and mathematics, Kim Williams book,Turin,2009))
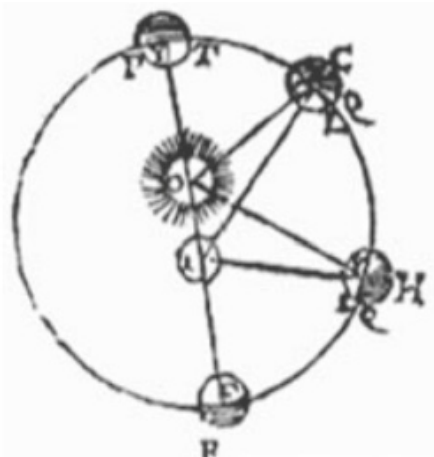
Fig. 2.2.2.6 Explanation of the absence of the higher planets
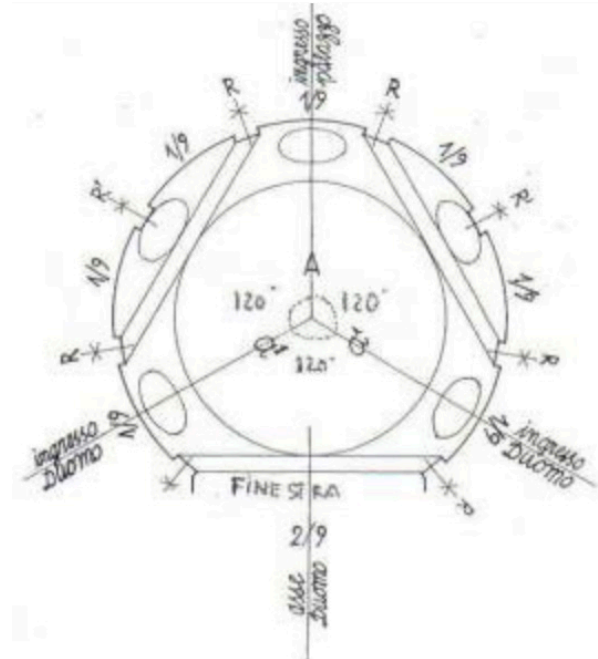
Fig.2.2.2.7. Chapel of the Shroud: plant, angles and numerical ratios (from Passanti, 1963)
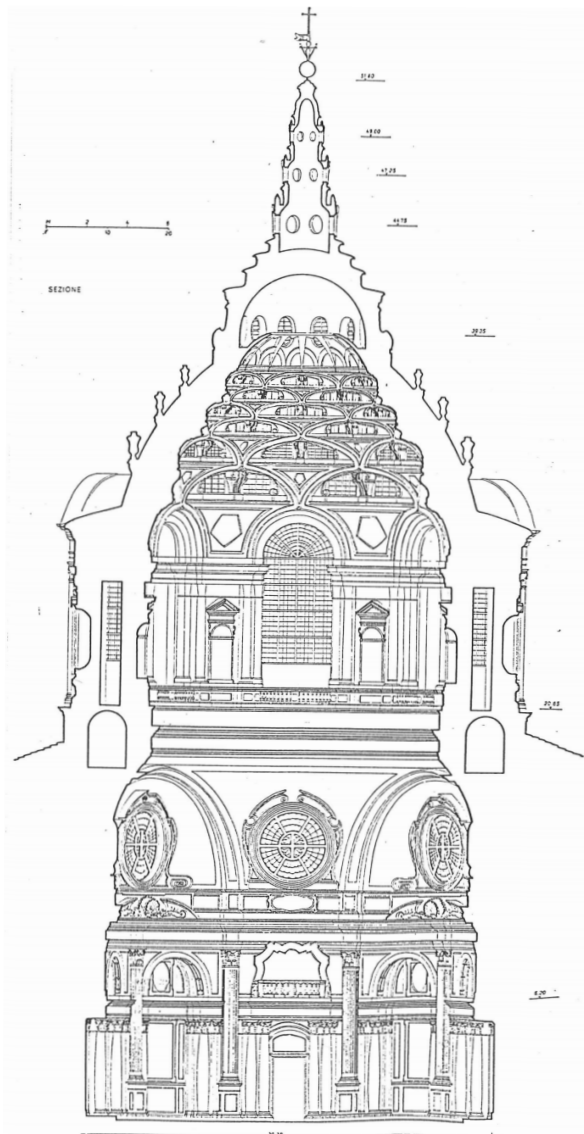
Section of Sindone, after Passanti.

Cappella della Sindone:Dome of the Starry Heavens.

The access to the Chapel of the Shroud was elaborated starting from unstable elements, contrasting with each other, able to satisfy a high public and not inclined to popular devotion. The three regular entrances, at 120 ° angles, left the privileged role to the Princes, who entered directly from the new wing of the Palace, and at the same time indicated to the pilgrims that crowded the church a one-way path that did not interfere with the functions of the Duomo.(Fig.2.2.2.2.7)

It was forced to rotate around the case in the two clockwise and anticlockwise directions (fig.2.2.2.8), according to a concept that privileged the historical time, the limit of a short season where every being, even high, lost its life.
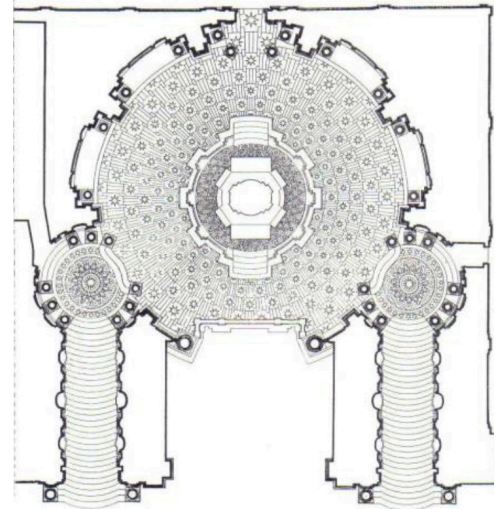
Fig.2.2.2.8. Chapel of the Shroud: staircases, atriums, floor and sacello (from Passanti, 1963)

MINOR SYMBOLISM.

Still with this theme or transformation and metamorphosis, we come to minor symbolism in the Sindone, beginning with the 'deformed hearts'.

The Heart.

The heart, Aristotelian seat of the soul and popular mediaeval symbol of the Passion (the Five Wounds), is found in the Upper Dome of the Blaeu Engraved Section. They occur as crowned hearts in the lowest range of decor at the springing of the Upper Dome. A fragrament from the Church of the Annunziata, Messina, is illustrated by Franco Borsi in ConvTor-1, p.(St.Francis de Sales(1567-1622) and St.Margaret Mary Alacoque(1647-90)) In an oval frame a winged heart bears a flame, and radiates an aureole. In both instances they are perfectly formed, and thus signify the Sacred Heart, which was then blossoming as a cult, still observed.(St.Francis de Sales(1567-1622) and St.Margaret Mary Alacoque(1647-90)) I have referred to the bulbous protuberances in each of the three wall panels on each side of the Stairs, (IS well as the most obvious of all, those over the Doors, none of which have been noticed in the literature. These are deformed hearts in the context of the theme of transformation introduced above. Guarini is careful to allow only the most particular of human forms to be deformed within the Sindone, and while it well portrays the anguish of human existence, it must also be read as the sufferings of Christ on His way up Calvary. As the hearts in the Stairs invite touching, they present the pilgrim a tactile experience in this shrine, where the object of devotion, the Shroud, is always concealed like the heart, except on the rarest occasions.(Sylvie Duvernoy, Nexus Network Journal:architecture and mathematics, Kim Williams book,Turin,2009))

Fig.2.2.2.8The 'Pentalpha' and Christ's Wounds, Valeriano's Hyeroglyphica

By:DI MARINA VALFRÈ DI BONZO

Dome of the Intelligible World. Again, the pentagrams may represent the fifth element, aether, the fire of the Empyrean or for Guarini, the perf~t light in a perfect diaphaniety. Secondly, the pentagram contains the golden section in its construction, so it may signify the only proportion allowable in the intellect's ascent to God. In cosmic terms it may be 'pars pro toto' for the duodecagon, the Platonic form for the envelope of the world, coming into being in the descent and expansion of forms. Both the pentagram and hexagon are gnomonic numbers, so both are emblematic of projection and emanation. Finally, following Valerianus, where the 'pentalpha' is a symbol of health, the pentagram represents not just the human body, but the body of Christ crucified, with the apices as the Five Wounds (fig.2.2.2.8). (Hieroglyphia p.599) Interpreting ancient poetry, Valerianus adds to health, Infinity and 'Principium et Finis', again appropriate in the context of the Sindone.

The light that penetrates from the star to the top of the dome slips to the black marble floor studded with bronze stars. The choice of the dark coating arises from the desire to avoid bright reflections that would divert attention from the precious central altar, custodian of the Holy Cloth.

The preciousness of the chapel is further enriched by numerous symbolic references: stars and hexagons represent the empyrean, the crosses are symbols of redemption, while the Passion of Christ lives again in the thorns and in the olive leaves.

For almost thirty years, the Turinese, looking up at Palazzo Reale, saw the dome of Guarini wrapped in sheets and wrapped in scaffolding. Its reopening is not just a big city festival, but an unmissable opportunity for the world to admire a pearl of the Baroque.(DI MARINA VALFRÈ DI BONZO,09.10. 2018,ARCHITECTURE & DESIGN)

centuries developed into the trigonometrical tables that we use today.(Bunt,Lucas N.H.et al, The Historical Roots of Elementary Maths, New York,1988,p.187) A further astronomical use was the combination of the triangle with the pentagram to produce the quindecagon, which Proclus used to find the Zodiac, and to find 'the obliquity of the ecliptic' .(Giving 24,Theon of Smyrna, inHeath ,Greek maths,II,p.242) These constructions anticipate the boundary of the upper heavens immediately beneath the

The duality of the five Platonic solids After a drawing by Michael Frame.

3.Sparkle concept design

After finding the most intensive Italic point, by deducing the specific project plan with a few points, the whole project has a clear outline and provides a framework for the third step of Travel to achieve the desired results. The analysis framework is divided into What Who When WHere and How. These five parts are the second step of Aware's basic framework to clarify the next design ideas.

WHAT-Starting from your italic case study,to understand which is the most relevent italic factor(bluster) taht you want to communicate and use to creat the sparkle with another italic to awake him/her.

WHOM-define the italic you want to reach:
where doed he/her lives, age, lifestyle in general

HOW-which technological solution/system you imagine to use,which kind of interaction and experience

WHERE/WHEN-where do you imagine to produce "the sparkle"? where the 2 italics meet each other? which place? In what occasion?

3.1 Development of Guarini Italic Point

Interdisciplinary

Event Planner

ART CURATOR

ART "ADULATRICE"

Experience Planner

SPACE LIKE MEDIA

EXPERIENCE ECONOMY

Entertainment Experience

Educational Experience

SENSORY SPACE

Escape Experience

Healthcare Experience

Aesthetic Experience

Gesamtkunstwerk:
Total aesthetic experience

COLLECTIVE
PROJECT

MERGE
SKILLS

PUBLIC/PRIVATE

PLACES OF
SOCIAL
AGGREGATION

EDUCATION

Pocket
Parks

CENTERS AND
URBAN SPACES

URBAN SPACE
LIKE CULTRUAL
ENGINE

Street Art

Urban
Cultures

Aggregation
Centers

Evasive
Groups

MEMBERSHIP
GROUPS

BAROQUE

PROMOTE A
CULTRUE

CULTURAL
INSITUTIONS

Golleries

Museums

Foundations

RELIGION

ENTREPRENEURS

DESIGNERS

PHILOSOPHERS
ENGINEERS

MAKERS

Etymology:
Re-Ligare(Latin):
Juin,Merge,Unite

ECLECTIC
PEOPLE

SCIENCE&
ART UNION

ECLECTIC
SYSTEM

3.2 SPARKLE

After finding the most intensive Italic point, by deducing the specific project plan with a few points, the whole project has a clear outline and provides a framework for the third step of Travel to achieve the desired results.

The analysis framework is divided into "What, Who, When, Where and How". These five parts are the second step of Aware's basic framework to clarify the next design ideas.

WHAT-Starting from the italic case study of Guarino Guarini, to understand which is the most relevant italic factor (bluster) that we want to communicate and use it to create the sparkle with another italic to awake the potential target. For this project, interdisciplinary is the most relevant italic factor of Guarino Guarini.

WHOM-is a group of potential targets which has some comment points with Guarino Guarini. It can be the way of thinking, similar education background, or same traveling experience. And is already under the influence of this Italic factor but has not awarded of it. This project is to create a product design for this group of people to wake them up. Analyze the place where he/she lives, his/her age, lifestyle, and give a scenario how he/she uses this project.

WHERE/WHEN-after analyzing the targets, creating a specific persona. According to their lifestyle where do you imagine producing "the sparkle"? where the target and Guarini meet each other? which place? In what occasion?

HOW- is a research about the latest technology to decide which technological solution/system can be used. Furthermore, think what kind of interaction and experience to build a strong connection between the target and Guarini.

Traveler

Study

Design

Interpreter

GUARINIANS

Influencer

Curiosity

Integration

Reserch
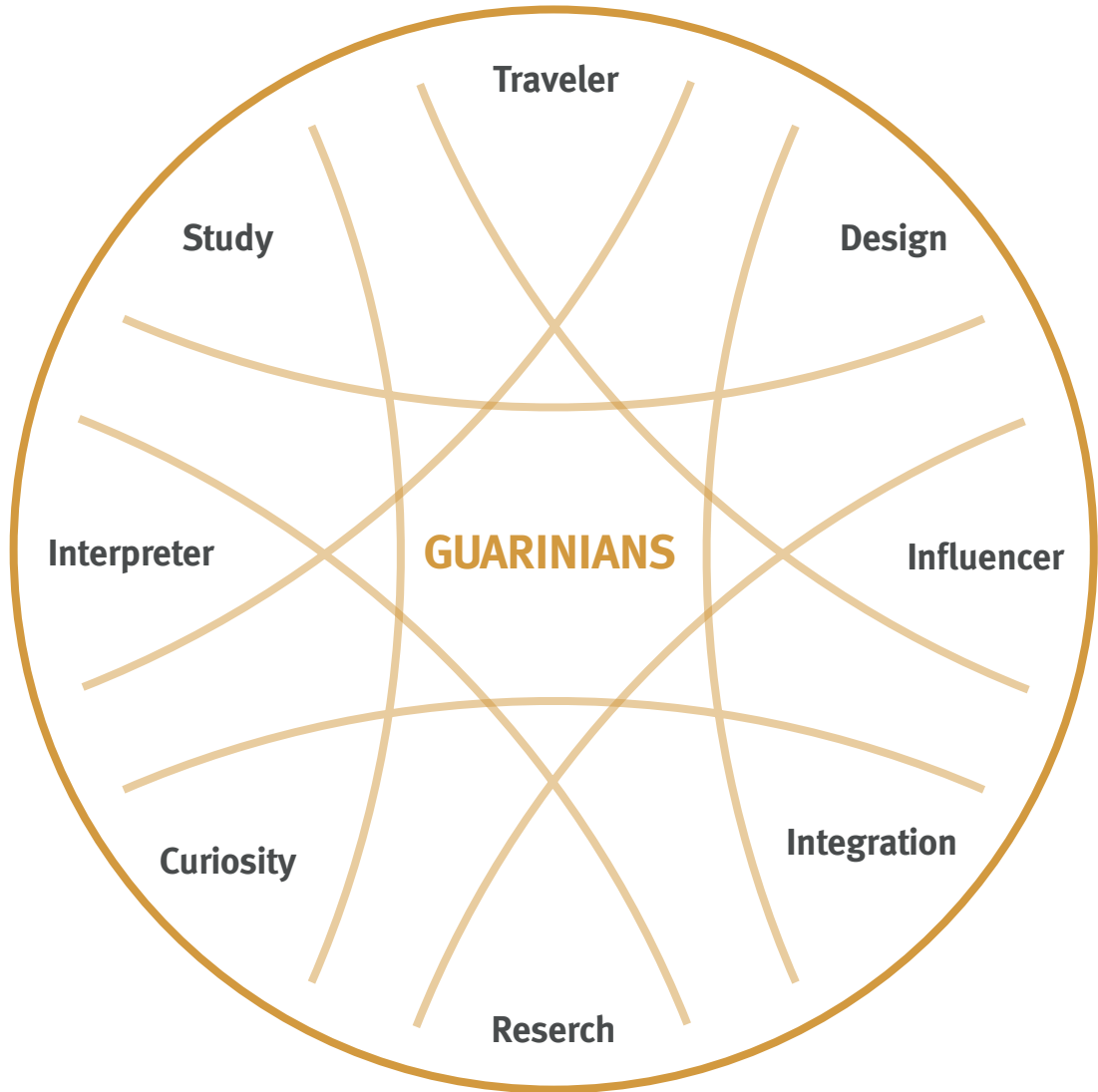
3.2 SPARKLE
3.2.1 Whom: Guarinian

3.2.1.1 concept of Guarinian

Guarino Guarini was an eclectic person, interdisciplinary is the key to understand his way to see the world. And Guarini was called Mercury of his Century. From this concept we have defined a kind of group of targets, that is the Guarinian. You can think this words as the people who has some thing common with Guarini. For this project it means the group of people who accept the knowledge from several filed with Multi-disciplinary background and thinking in an interdisciplinary way**.**

https://susanklaiber.wordpress.com/

3.2.1.3 Target: Young maker

It cannot be ignored that Guarini is also a teacher. His life's work is devoted to spreading the knowledge he has learned to the general public. According to relevant information from a blog created by Susan(http://guarinoguarini.blogspot.com/), in 1640, when he was 16 years old, "Guarini spent his novitiate at San Silvestro al Quirinale, the first Theatine church in Rome. After taking his vows, Guarini continues his training for the priesthood with studies in philosophy and theology. although traditionally assumed to have pursued his studies in Rome, one source suggests Guarini may have studied in Venice in early 1645.

Guarini's cognitive breadth is based on the education in study period. There is a group in the 21st century, which can be regarded as a prototype of Guarinian to some extent. It's Young Maker (Maker age from 8 to 12). You can think Maker as the people who willing to create something. Especially the young maker who accept the STEAM education. Next, I will introduce this child education model that has emerged in the world in recent years.

EindhovenMaker Faire (BY-NC-SA)

EindhovenMaker Faire (BY-NC-SA)

STEAM Education

STEAM education is short from 5 different field of Knowledge, they are Science, Technology, Engineering, Arts and Mathematics. It is different from the traditional single-discipline education that emphasizes book knowledge, and it is a kind of super-discipline education philosophy that emphasizes practice. Specifically, STEAM education is not just about learning about these five subjects, it's about a new way of teaching: letting students do their own projects that they're interested in. Which are relevant to their lives, and the student will learn about different subjects and disciplines along the way.

There are many kinds of courses in the market, like robot education, natural science and children programming education. Following the call of STEAM education, robots and 3D printers have entered the schools. Educational technology products like teaching aids are popping up to help children learn different knowledge.

Students who involved in this model can be regarded as potential Guarinians, based on the idea that they receive interdisciplinary education from an early age. Young makers with the STEAM education background are the target users of this project. Of course, any design for children should also consider the teachers, parents and other adults around the group of children. A child grows up under the guidance of parents and teachers, and the major decisions about education are always made by their parents.
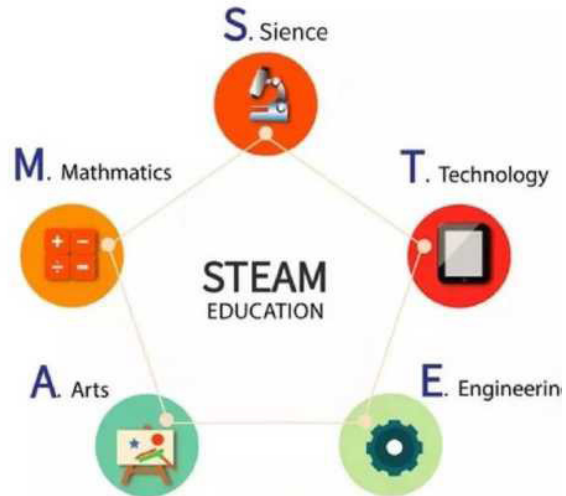
Due to the improvement of parents' education level in recent years, it seems that they are willing to pay more attention to the quality of their children's education. As the parents with high level education background, due to their acceptance of knowledge, the majority of them want their children to enjoy the power of education. In addition, the salary level of parents with high education background is also improved compared with that before (). And the proportion of children's education investment in the living expenses increases year by year. Teachers, as the most important participants in the educational process, are also set as target users. Since the teaching process involves multiple parties, only analyze the needs of children is not enough and complement. The teachers' own conditions and overall teaching environment should also be taken into account.

EindhovenMaker Faire (BY-NC-SA)

Maker

What is a maker? It`s easy to understand, maybe you have this kind of memory that in your childhood, your grandfather gave you a funny toy made by himself. At that condition, your grandfather is a maker in the past time. As for making this funny toy, he is willing to experiment and share his idea. He made it by his own way according to his previous knowledge and turn the idea into reality. In the digital World, maker has more definition.

The common characteristics of maker are innovation, practice and sharing. Makers often have a variety of interests. In his book "Maker", Chris Anderson, describes makers as "first, they use digital tools, design on screen, and increasingly use desktop manufacturing machines to make products; Second, they are the Internet generation, so instinctively sharing success online, introducing manufacturing processes through Internet culture and collaboration, they are working together to create the future of DIY on an unprecedented scale. "The chief executive of Tech-Shop Mark Hatc, said that "a guest movement is the core of better access to tools, open access to knowledge and build everyone involved distribution system. "

Students based on STEAM education model have multi-disciplinary education background. However, applying interdisciplinary knowledge to development and creation is a new type of interdisciplinary Maker, which is an upgraded version of the early Maker team. With the popularization of democratized technology, makers are no longer limited to individuals who are passionate about invention, which is the target group of this time: Young Maker.

For this project the age of Young Make is between 8 to 12. Why I choose this age grades? First of all, this group is the earliest group receiving Steam education, as STEAM education getting popular among the America in 2015 and spread into China recent years. STEAM education fosters the mindset and 21st century skills of young makers. Furthermore, enables young people to create innovative solutions for their communities, and prepare the ability they need for future work. Since the project of Italic is oriented at 2025 and beyond, Young Maker will grow into a group of latest adult makers and make full use of what they have learned and thought to change the world.

Maker education emphasizes action, sharing and cooperation, as well as integration with new technological means. From this gradually develops for the interdisciplinary innovation ability training new way. Some famous universities in the world will have a practice as an interdisciplinary innovation and important mode of experiential learning, such as the Massachusetts institute of technology to establish the students' operation and guest room MITERS, change learning technology laboratory at Stanford (Transformative Learning Technologies Lab) is for the world's a guest room and rapid prototyping Lab to create open source course (Stanford Fab-Learn Fellows Program). We can see these places are all aimed at adult students. For the Young makes who receive such educational concepts in early period, they will surely bring us greater surprises in the future development. So, what we design for now is to design for the future human been.

GUARINIANS
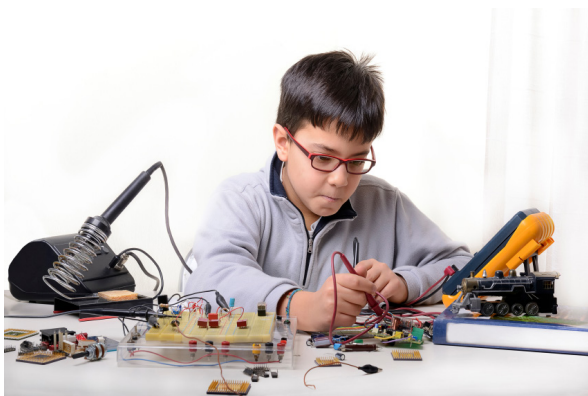
Name_Sam

Info
Age_8
Occupation_Primary Student
Status_Teeny Maker/ Inventor
Location Beijing
Hobbies_Guitar
Archetype_Young inventor

Skills and Attributes
Tech-Savvy
Electronic parts assembly
Community oriented

Frustrations
Fast change of information in the digital age.Too many questions don't know who can answer.

Goals
Explore the world infinity in my own way

Curiosity
Exporer

GUARINIANS

Name_Emilia

Info
Age_42
Occupation_International kindergarten Teacher
Status_Maker group guider
Location_Australia
Hobbies_Drawing/Photography
Archetype_Gentle mother

Skills and Attributes
Creative expression
Patient guidance for everyone
Full of love for life

Frustrations
Repeatedly teaching the same course, I don't
know how to keep up with the development of
the times and better interact with students.

Goals
Let students enjoy the classroom teaching
process and benifit from the course.

Invent
Study

What is a Young Makers?

Creation
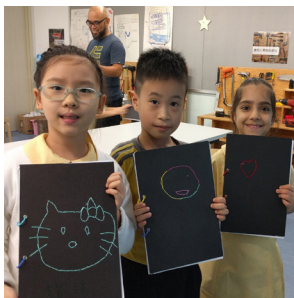
Co-Learning

Young Maker

Interdsci-plinary

Tech Savvy

What young people make ?

https://www.makerspaces.com/makerspace-guide-school-and-library/

Already making

Want to make more of

Digital Pictures	76%	15%
Edited videos or visual effects	62%	23%
Music	53%	21%
Animation	56%	22%
Games	53%	33%
Websites	53%	22%
Temixes	40%	12%
Apps	46%	26%
Software	52%	15%
Robots	34%	19%
3D printed objects	31%	23%
Edited photos	76%	13%
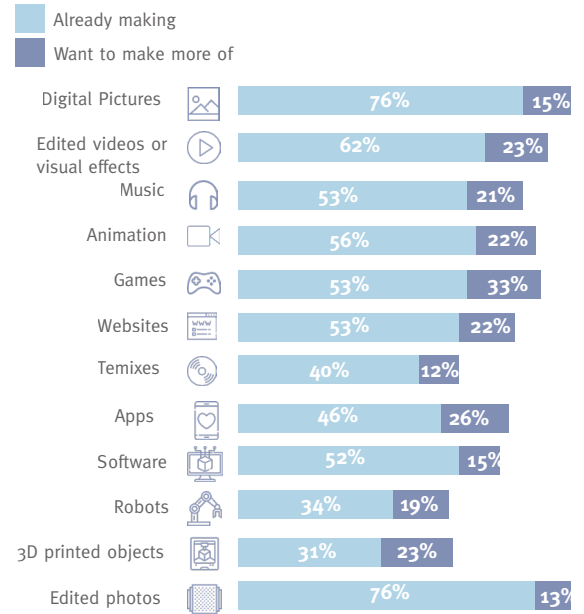
Data resourse: Young Digital Makers(Surveying attitudes and opportunities for digital creativety across the UK)-Oliver Quinlan MArch 2015

ECONOMICS_YOUNG MAKERS(Parents)

AVG- Average of citizens
YM- Young maker family

Household Spend

Education Spend

Traveling Spend

Family income

Deposit
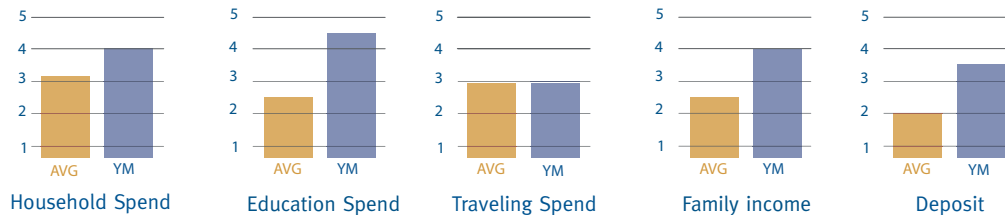
LIVING

NUTRITION

Well - cared

Balance

"Twenty-tens"

Alipay

POKÉMON

WeChat
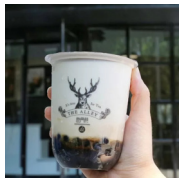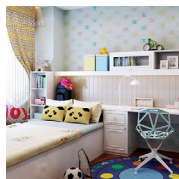
Sharing
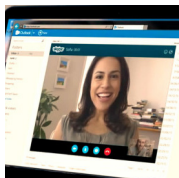
TRANSPORTATION

COMUNICATION

3.2 SPARKLE
When & Where: Youth maker space

Definition for Maker Space

So, what is Maker Space? It can not only be described as a classroom or workplace with some high-tech device. Makerspace becomes the carrier of maker culture. For the maker practice in the primary school, students are regarded as creators rather than consumers. And schools are changing from centers of knowledge transmission to centers of practical application and creation. The proliferation of academic maker Spaces and rapid manufacturing laboratories, where students can develop course projects and self-directed projects. As well as content - and product-centric teaching activities, is demonstrating educational value in innovative forms. Maker practice is creating an organizational culture that encourages students to engage and come up with creative solutions to real-world problems.

http://himcoding.kr/him_m/

The following are the opinions of those who have made out-standing achievements in the field of maker education on maker space. We can go deeper understanding of maker culture.

Silvia Lindtner （3） from the university of Michigan summarized four spatial forms of makers:

Early membership social network open organization international maker movement and product incubation platform.

Dale Doughety, chief executive of producing magazine, defines the hackerspace as "a place where creative people from different professions, communities and communities come together, share with each other, meet like-minded people, and turn ideas into reality."

According to Kera. D, a maker space can be defined from a series of sharing technologies related to open source software, hardware and data, governance process and values. Mitch Altman, founder of Noise bridge, believes that in the maker space, people can explore what they love and get support from the community by hacking, which is to maximize their capabilities and be willing to share.

Maker space represents the democratization of design, engineering, manufacturing and education. Makerspace is a tool-equipped community center that provides community members with the resources to design, manufacture and create works by integrating manufacturing facilities, communities and education. These Spaces are loosely structured individual Shared Spaces and tools that can be operated by for-profit enterprises, non-profit enterprises, affiliated or hosted in schools, universities, etc.

"China has the largest number of incubators and makerspaces in the world, "as state-owned People.cn reports.(4) "According to data from the Torch High Technology Industry Development Center of the Ministry of Science and Technology, China owned 3,255 incubators and 4,298 makerspaces at the end of 2016.By 2020, the country aims to increase the number of domestic incubators and makerspaces to more than 10,000, with another 100 overseas. These programs are expected to create three million jobs and 2,000 listed companies. "

In recent years, China, especially first-tier cities such as Beijing, Shanghai and Shenzhen, has vigorously developed maker cultural activities. The age group of maker education is gradually extended to children, and various schools have set up maker activity rooms to carry out maker activities. Maker education relies on advanced information technology, as well as well-equipped space and platform with rich contents. Such innovation space is a challenge to the traditional classroom.

Not only for the physical environment, Maker education also poses problems for teachers. The content of maker curriculum system is novel, and there is a lot of relevant subject knowledge in the design, but most teachers' knowledge is not enough to match the demands. When facing the actual teaching, it is easy to make scientific mistakes. The arrival of artificial intelligence era has given birth to the development of maker education technology. The Internet has become a big push for the development of maker education, which not only relieves the distribution of excellent educational resources, but also allows artificial intelligence technology to share a certain amount of teaching workload for teachers. For these advantages, in this project I choose the maker space as the "where". A product system based in the maker space, using artificial intelligence technology to assist the teacher also interaction with student.
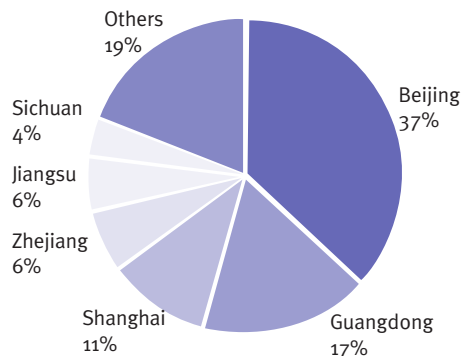
TERMINAL

FOR

DATA
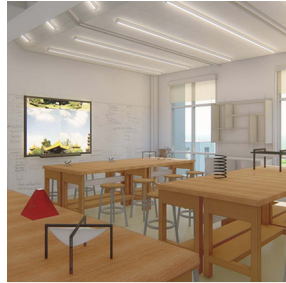
INPUT

AND

OUTPUT
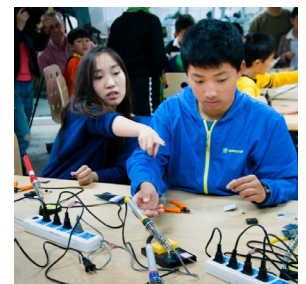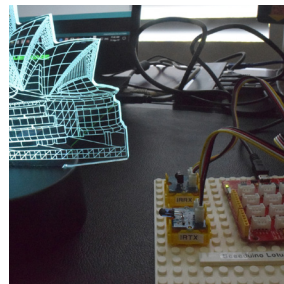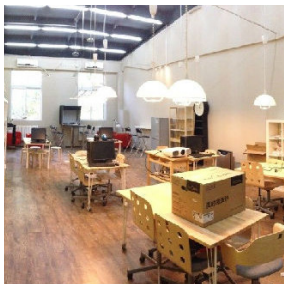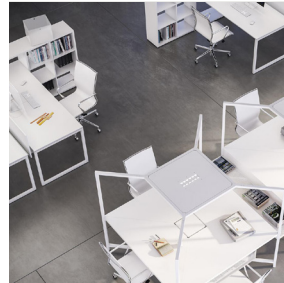
CO-

LEARNING

SPACE

BEIJING
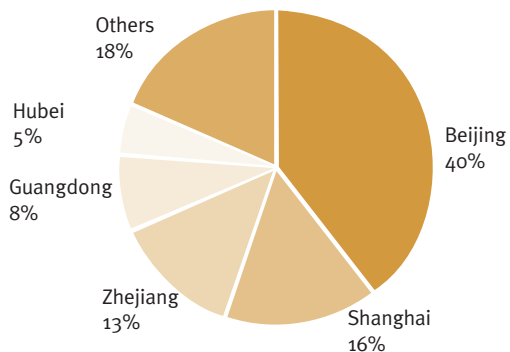
MAKER

SPACE

Geographical distribution of AI education projects

• AI education projects are mainly concentrated in first-tier provinces and cities such as Beijing, Guangdong, and Shanghai, with Beijing being the largest, accounting for 37%.
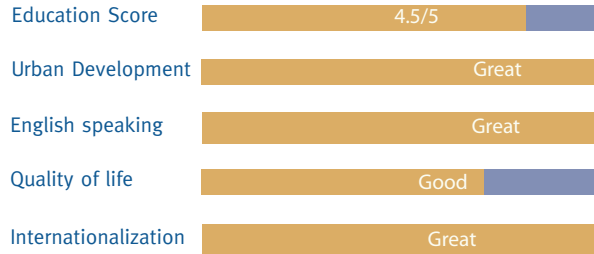
Geographical adaptation of Adaptive learning based on AI educational projects

• The adaptative learning based on AI education program is also concentrated in the first-tier provinces and cities. Compared with AI education, the proportion of Guangdong Province has decreased. The top three are Beijing, Shanghai and Zhejiang.

Data Sources : www.jingdata.com

SOCIETY_BEIJING

Education Score	4.5/5
Urban Development	Great
English speaking	Great
Quality of life	Good
Internationalization	Great

Why do people visit makerspcae?

Hobbyist	32%
To learn	30%
To set up a company	21%
Other	17%

"Other" includes visits from government officials and companies

Main Challeng: Funding

It's said that 52% makerspaces concerned about funding, in the research result " Made in China"-Makerspaces and the search for mass innovation, by Tom Saunders and Jeremy Kingsley, in March 2016.

20%
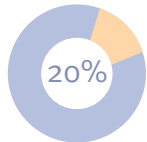
Funded by a **parent company**

34%
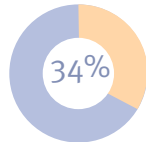
Received **government support**, from grants to subsidised rent

24%
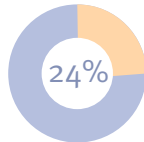
Have **no income** and are supported by volunteers

3.2 SPARKLE

3.2.3 How: Technology and Concept (interface,project.)

During the baroque period, new discoveries in science and new creations in technology greatly broadened the horizons of some architects, liberated their minds, and made them unwilling to conform to the conventions. "Anyone who doesn't break the rules once in a while can never surpass them," said Bernini. As Guarino Guarini（5） said, "architecture should revise the old rules and create new ones." With the power of science and technology and the brave spirit of innovation, many new ideas, new techniques and new forms shine brightly in baroque architecture. The combination and collision of science and technology and art bring out more incredible possibilities. The following is based on the investigation and exploration of existing science and technology.

Young maker (Beijing)

**Guarino Guarini
(Background)**

Teacher

Creation

**Interactive Terminal
Product system**

Guidance
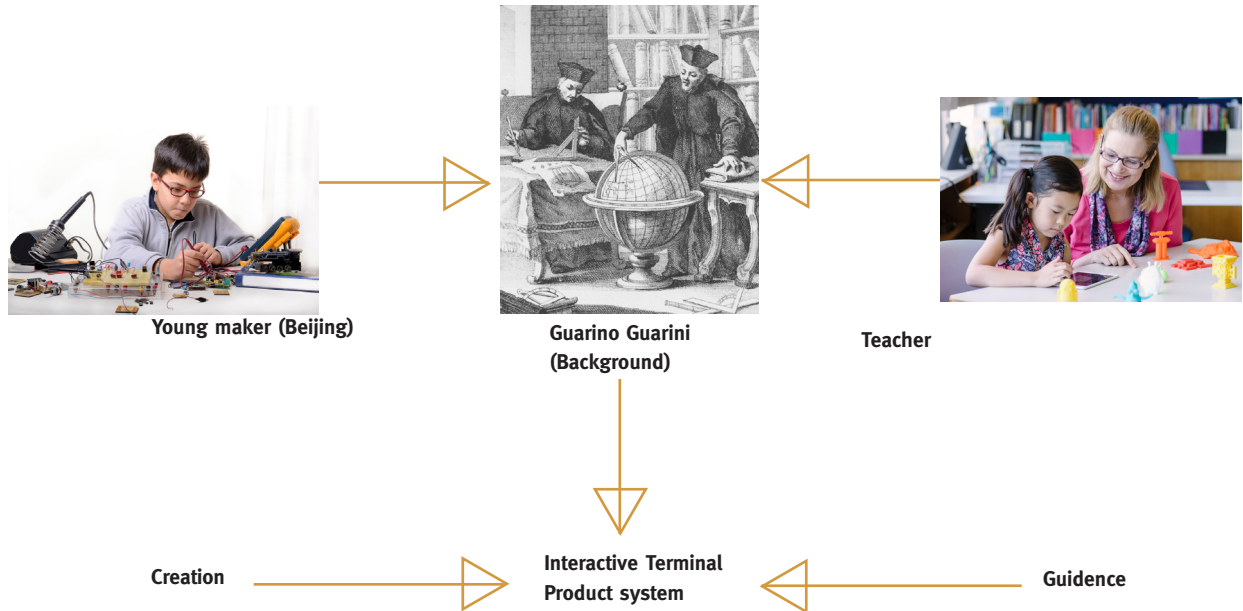
3.2.3.1 Data into things, things into data

The 20th century has seen some major developments in various fields: digital computers, data storage technologies, and software for writing computer programs, advances in sensor technology, and derivation of mathematical control theory. The development of all these tools has promoted the progress of automation technology and gradually saved people from their heavy operations. With the advancement of computer technology, program storage technology has also made similar improvements in terms of including programming commands.

"Artificial intelligence is a high-level area of computer science. Computers are programmed with features related to human

intelligence. These characteristics include learning ability, understanding language, reasoning, problem solving, presenting expert diagnosis, and similar mental abilities. It is expected that the development of artificial intelligence will provide robots and other "smart" machines with the ability to communicate with humans and accept high-level instructions, rather than the detailed step-by-step programming statements that are currently required for programmable machines, "said by Milekk P.Groover(6) in his book.

The evolution of production and living tools affects all aspects of human life, and the constant demand by humans for new ones also contributes to the advancement of tools. Consumer products ranging from cars to small appliances have been automated to bring benefits to users. Microwave ovens, washing machines, dryers, refrigerators, video recorders and other modern household appliances often contain a microprocessor as the computer controller of the device. You just need to push the button, and everything is done.

Neil Gershenfeld（7） said "A new digital revolution is coming, this time in fabrication. It draws on the same insights that led to the advanced digitization of communication and computation, but now what is growing program the physical world rather than the virtual one.""In today's learning environment, data plays a pivotal role in helping instructors and administrators personalize learning for students and make optimal instructional decisions for their schools, districts, colleges, and universities," said Wil Lampros , the president of ALEKS.

This new era of digital custom production is seen as the beginning of the new industrial revolution: it also has the ability to democratize manufacturing and disrupt the global supply chain. Widespread access to these technologies will challenge traditional models of business, foreign aid, and education. The revolution is not additive versus subtractive manufacturing; it is

the ability to turn data into things and things into data. Especially for the education part, one teacher takes charge of dozens of students. During the whole career life, he/she repeats the same teaching content year by year. Spending much time on checking the dozens of pieces of homework, the repetitive work may damage the patient.

Think back to our study period, if you're not one of the top performers in your class, you may feel that your teacher is paying more attention to the top performers. But in fact, because of the large number of students in the class, the teacher cannot take care of all the students, so the outstanding students will be more impressive. This experience might affect your learning motivation more or less, but we should not be too harsh on the teacher as a mistake. After all, teachers are not machines that can process multiple information at the same time, but with the help of artificial intelligence, teachers can know how well each student receives in class. By comparing the completion of each individual student in each operation by the algorithm, teachers can get a deeper understanding of students' progress and give timely positive feedback to increase students' learning enthusiasm.

3.2.3.2 Adaptive Learning based on AI

The application of artificial intelligence in education

Artificial intelligence is an interdisciplinary subject that integrates computer science, physiology and philosophy. It is a technology that USES machines to replace human beings to realize cognition, recognition, analysis, decision-making and other functions.
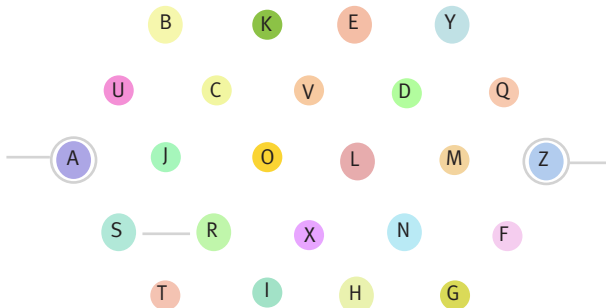
In learning, artificial intelligence can be applied in testing, practice, learning and teaching, which can be divided into recognition class and strategy class. The recognition categories in AI education include photo search, intelligent assessment, intelli-
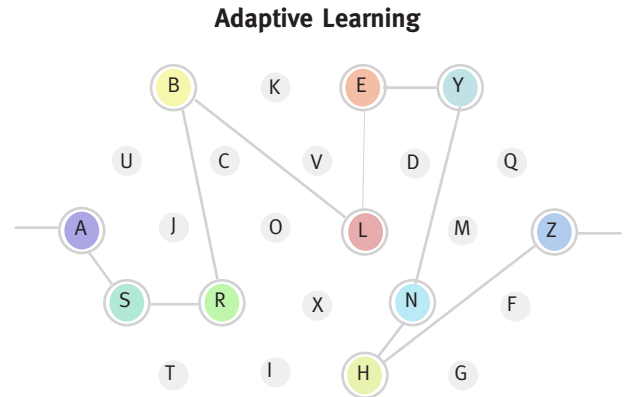
Adaptive Learning

Traditional Learning

With adaptive,your content becomes a network

gent marking, etc. Which specifically apply image recognition, speech recognition, semantic recognition and other technologies. Strategy class is mainly adaptive learning system, mainly using information theory technology, Bayesian theory, knowledge space, genetic algorithm and other technologies.

Adaptive Learning Overview， Classification and the development
Adaptive education is a way to provide students with personalized learning, by tracking the students how to answer this question, and answer based on their specific behavior. Recommending the corresponding learning path, in order to better adapt to students' individual learning needs, do according to their aptitude, are divided into regular adaptive education and the irregular adaptive education.
Here is the simplified definition of regular adaptive education and irregular adaptive education.

Regular Adaptive education: the rules of the link between the knowledge points of adaptive education is relatively simple. Based on the simple logic "if - and then", has a fixed sequence of online learning. The system according to predefined rules, will study content to the user. And provide the students with learning path planning. As it's not a real time data collection, it's unable to real-time feedback and adjust learning path according to the user's behavior. The logic structure is like this image. () In a conclusion the regular adaptive education could not fix everyone' condition and adjust for individuals.

The irregular adaptive education: using artificial intelligence, cognitive science, data mining. And knowledge such as pedagogy, psychology, behavior science, continuous and real-time data collecting students' learning. According to the learners' learning objectives, learning behavior, preferences and learning status real-time dynamic adjustment and optimization of path. In order to achieve the purpose of personalized teaching. This kind of adaptive education based on AI technology is called irregular adaptive education based on artificial intelligence. The logic structure is like this image. ()
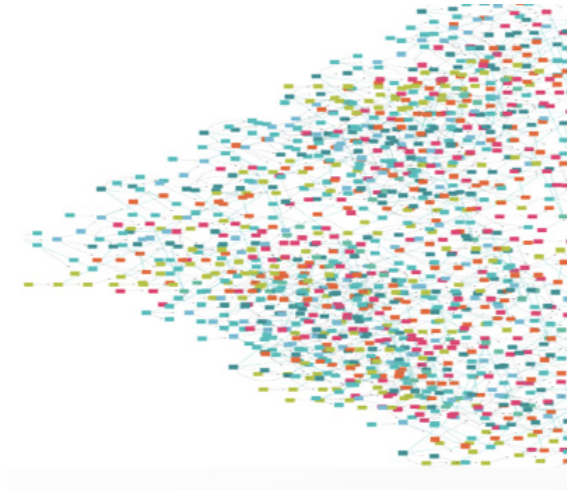
The concept of self-adaptive education has existed for a long time, and its formation is usually related to b. f. Skinner 's teaching machine and his programmed learning theory. This theory emerged in the 1950s, and since 1970s, intelligent teaching system has emerged through computer-aided teaching. In recent years, as big data, artificial intelligence and other technologies continue to mature, gradually from theory to application, promoting the rapid development of adaptive education of artificial intelligence. It can give teacher real-time evaluation and feedback according to students' learning situation to help teacher adjust the teaching speech in time.

3.2 SPARKLE

3.2.3 How: Technology and Concept (interface,project.)
3.2.3.1 Case Study

The case study is a comparation about several companies work for the irregular adaptive education based on artificial intelligence. They are Knewton, a platform founded in New York; ALEKS, a service provider of adaptive learning systems in America; RealizeIt, an educational product of CCFK, a provider of adaptive education solutions for ToB terminal; CogBooks, an educational technology company founded in the UK in 2005 to develop adaptive learning tools; Knowre, Real-time assessment of students' knowledge to guide their future learning direction; Smart Sparrow, a teaching design and courseware platform for university courses. These companies are the top in the whole world which take the effort on the adaptive learning. Each of them has their strategy to get the benefit from, by analyzing the business model, product (product here can be a service system, a platform or some learning tools), the interface and so on, to get a rough understand of the adaptive learning market. For doing this, it will provide the possibility and construction about how this project can be done. Also, a guidance and a reference about what kind of technology to achieve the desired results.

Through scan the home page of each company and refer to it from the data based on the AI industry research report of the Jingdata Research Institute(8). Also take reference from some white papers from each company, to analyze how they manage the adaptive learning courses and activities.

KNEWTON

1.Knewton

Knewton is an artificial intelligence adaptive learning platform founded in 2008 in New York City by Jose Ferreira (founder of the term adaptive education).The core product is an adaptive learning engine, which takes a leading position in the world in such technologies as student learning data collection and personalized learning content push. Having been widely cited by the international education circle and is a benchmark enterprise in the field of self-adaptation.

Business model: B-side(Business)collaboration, working with universities and content publishers to digitize various course materials to provide adaptive learning solutions for these products.

Product analysis: Knewton is committed to be an artificial intelligence adaptive learning platform, which does not provide its own content and cooperates with content producers such as schools and publishing houses. In digital adaptive learning course, Knewton embedding partner content through the API to their system, the artificial intelligence, adaptive learning platform for students behavior data collected through continuous, real-time response to the students in the system activity, students complete an activity, the system automatically push students to the next activity. The above analysis from Knewton - the adaptive learning – whitepaper(9).

"Alta is Knewton's fully integrated, adaptive learning courseware. A complete course solution, alta is designed to optimize the way students study and learn while completing assignments. All of Alta's content — including instructional text and video, examples and assessments — is organized by learning objective and served up at the precise moment a student needs it."-from Knewton website.

Knewton is committed to being an artificial intelligence adaptive learning platform that does not provide content and cooperates with content producers such as schools and publishers. In the digital adaptive learning course, Knewton embeds the content of the partner into its own system through the API. The artificial intelligence adaptive learning platform conti-nuously responds to the student's activities in the system by continuously collecting student behavior data, and the student completes a certain item. After the event, the system automatically pushes the student to the next activity.

Knewton adaptive learning platform basic process

Split the learning con-tent into each knowle-dge point to form an associated knowledge map

Collect students' lear-ning behavior on the system

Through student behavior, the algorithm recommends a persona-lized course of learning, setting tasks and goals.

Lauren

■ Equations and expressions	■ Ratios and proportions
■ Statistics and probability	■ Geometry
■ Algebra	■ The number system
■ Functions	

figure e.
LAUREN'S PERSONALIZED
LEARNING PATHWAY

William

■ Equations and expressions	■ Ratios and proportions
■ Statistics and probability	■ Geometry
■ Algebra	■ The number system
■ Functions	
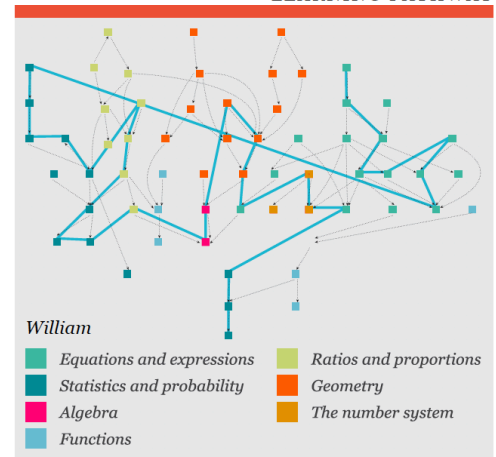
figure f.
WILLIAM'S PERSONALIZED
LEARNING PATHWAY

Knewton-adaptive-learning-whitepaper.pdf

ALEKS adaptive learning path planning diagram

The full state.

The empty state.

What_Makes_ALEKS_Unique.pdf

Mc Graw Hill ALEKS®

2.Aleks

ALEKS is a service provider of adaptive learning systems based on artificial intelligence engines, according to the ALEKS website. Founded in 1996 in the United States. It provides a personalized learning experience based on each student's strengths and weaknesses.

Business model B - end institutional clients are charged. Product analysis: The ALEKS PPL system is divided into three stages: positioning, preparation and learning. The program can reflect the unique knowledge state of each student and divide each student into specific preparation and learning modules of the course. Different from the traditional standardized tests and written exams, ALEKS PPL pays more attention to the personalized knowledge gap of students and makes a seamless transition between orientation assessment and orientation learning modules, so as to motivate students to achieve higher scores.
This new Custom Reporting feature provides ALEKS instructors and administrators with a
powerful tool designed to help them gather, evaluate, and compare data to support instructional decision-making. For added convenience, custom reports can be scheduled to run once or on a recurring schedule, such as weekly, saving valuable time and resources.

What_Makes_ALEKS_Unique.pdf

https://www.aleks.com/independent/students/qt_tour_print

ALEKS + − × ÷ QuickTables®

ALEKS QuickTables is a Research-Based Online Math Facts Program:

Research-based program with individualized assessment and learning

Covers 0-12 range of facts for multiplication, division, addition, and subtraction

Content correlated to NCTM standards

Ongoing practice helps students learn and recall facts

Interactive games provide additional review and built-in rewards
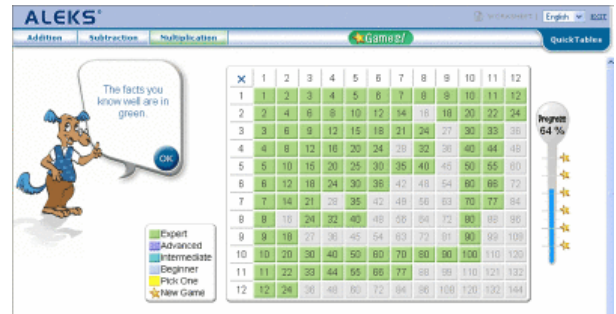
REVIEW

In ALEKS QuickTables, the memorization of math facts is facilitated by a distributed practice mechanism that closely adapts to the individual student. This enables a learning sequence that carefully mixes new and partially mastered problems, gradually moving the learned facts from short-term memory to long-term memory.
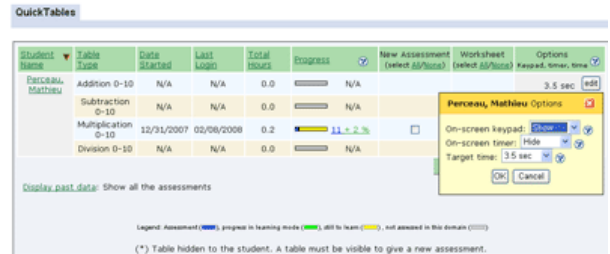
https://www.aleks.com/independent/students/qt_tour_print

STUDENT PROGRESS

Students can choose to have access to an onscreen keypad and timer, as well as customize time settings.

CogBooks™

4.CogBooks

CogBooks is an educational technology company founded in the UK in 2005 to develop adaptive learning tools. The concept of adaptive learning of Cogbook is reflected in the tool properties, which can help teachers generate courses automatically and give real-time evaluation and feedback according to students' learning situation.
Business model: According to the needs of the teachers, it provides teaching courseware, analyzes the learners' learning and answers, and adjusts the interaction with the students' course content based on the analysis results
The product design

Intelligent algorithms: analyze student course interactions to continuously provide learning content that best suits individual learning paths.
Teaching assessment: real-time assessment of knowledge acquisition, so as to guide the subsequent learning direction.
Arrange the course according to the textbook: follow up the students' understanding of the course chapters to arrange the appropriate volume and sequence of the course.
Self-test questionnaire: self-test questionnaire is provided to help students to test the adaptive learning results.

Courseware is 'purpose-built software that enhances the delivery of an entire course'

Emerging	Developed	Strong	Excellent
Blended learning is restricted to a small number of individual faculty 'early adopters'	Flipped Classroom in multiple departments, with a level of data analysis and use	Use of digital Courseware is encouraged, with strong institutional support.	Widespread adoption of high quality personalized adaptive Courseware and data analytics.
→	→	→	★
CogBooks provides a rich on-line resource of content, with built-in adaptive personalization. Faculty find it easy to adopt CogBooks' readymade Courseware within their existing approach, while beginning to experiment with new teaching methods.	CogBooks provides proven tools that encourage faculty to adopt enhanced teaching methods, enabling e.g. an organic transition to a 'flipped' classroom. Dashboards provide insights into students and introduce faculty to the power of data in supporting teaching decisions.	CogBooks provides a repeatable approach which simplifies adoption beyond the 'early adopters' and into the mainstream faculty and teaching stage. We can help with a planned expansion to multiple disciplines, providing support and faculty training throughout.	CogBooks provides scalable infrastructure and methods to support institution-wide adoption of both Courseware and analytics. CogBooks provides an integrated solution for connecting learning across the whole curriculum for any discipline.

Learner - Performance   Dashboard

Interface resource： http://www.cambridgegcsecomputing.org/
sites/94/upload/userfiles/understanding_the_dashboard_v1.pdf

5.Knowre

Real-time assessment of students' knowledge to guide their future learning direction.
Business model: Knowre aims at the global mathematics education market and mathematics education programs for users. In order to realize personalized mathematics education, Knowre develops the "Knowledge Engine" to help students digitize their Knowledge structure. Based on this, it obtains and analyzes unit-level data and makes personalized mathematics learning content for students.
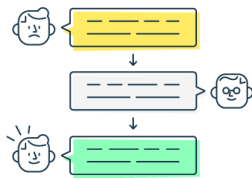
Practice with Support
When a student is struggling with a specific skill, we provide interactive, step-by-step support, drilling down to underlying concepts, just like a teacher would.
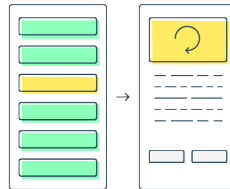
Fill Gaps with Personalized Review
Our technology assesses each student's strengths and weaknesses and fills learning gaps with algorithmically generated problem sets personalized to each student.

Target with Actionable Data
Our Teacher Dashboard shows student achievement in an easy-to-read format so that teachers can quickly identify students who require additional help.

Product Design

Teacher interface: Knowre system will make statistics of each student's learning progress and learning difficulties encountered by individual learners/whole class to the teacher.
Knowre's Teacher Dashboard: shows student achievement at a glance so teachers can quickly identify students who may need extra help.In just three steps, teachers can assign lessons and review problems to one, several, or all students and set submission dates.
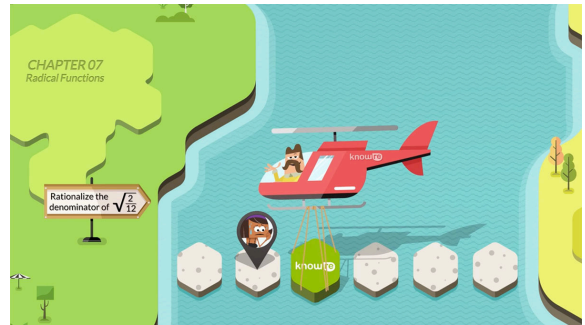
Students' user interface: Knowre system will test students' strengths and weaknesses, and customize personalized courses according to the results of algorithm research

6.Smart Sparrow

Smart Sparrow is a teaching design and courseware platform for university courses. The platform is dedicated to assisting teachers and instructional designers to develop online courses based on students' individual needs.The world's first Adaptive eLearning Platform, backed by research.

Business model: Working with higher education institutions and companies, teachers use the Smart sparrow platform to create their own curriculum content.
Smart Sparrow works with higher education institutions and businesses to create analog, digital and hybrid programmes for different disciplines; Students adjust course paths through interactive simulation and adaptive tutorials, and teachers and instructional designers use the Smart Sparrow platform to analyze which work is more effective in the teaching process, so as to modify courseware content and help students achieve a better learning experience.
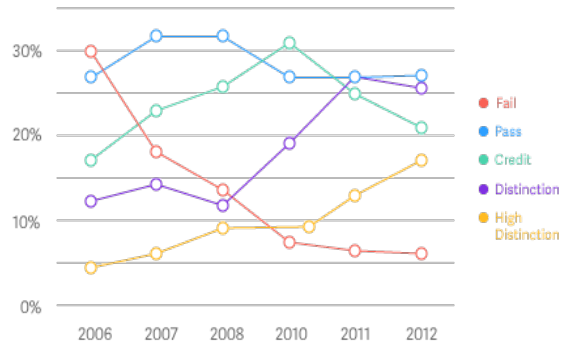
Improved student achievement as more adaptive courseware is introduced over time
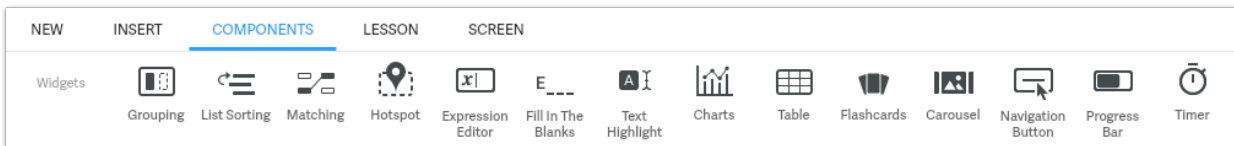
"While working with clients across many different projects, we have developed custom components — widgets, simulations, games, and apps — that enhance online learning experiences so students dive into the subject matter and develop a deeper understanding.

Today, we're making our collection of custom components available for all Smart Sparrow users to utilize in your teaching and learning. We have introduced additional advanced components to the Author and added others to the free Component Library."

Multiple choice	Free response	Charts	Graphs
Drag and drop	Fill In the blanks	Matching and ordering	Visual tools
Lesson navigation	Math	Medical	Science

https://www.smartsparrow.com/2018/05/02/creating-more-interactive-lessons-with-smart-sparrow/
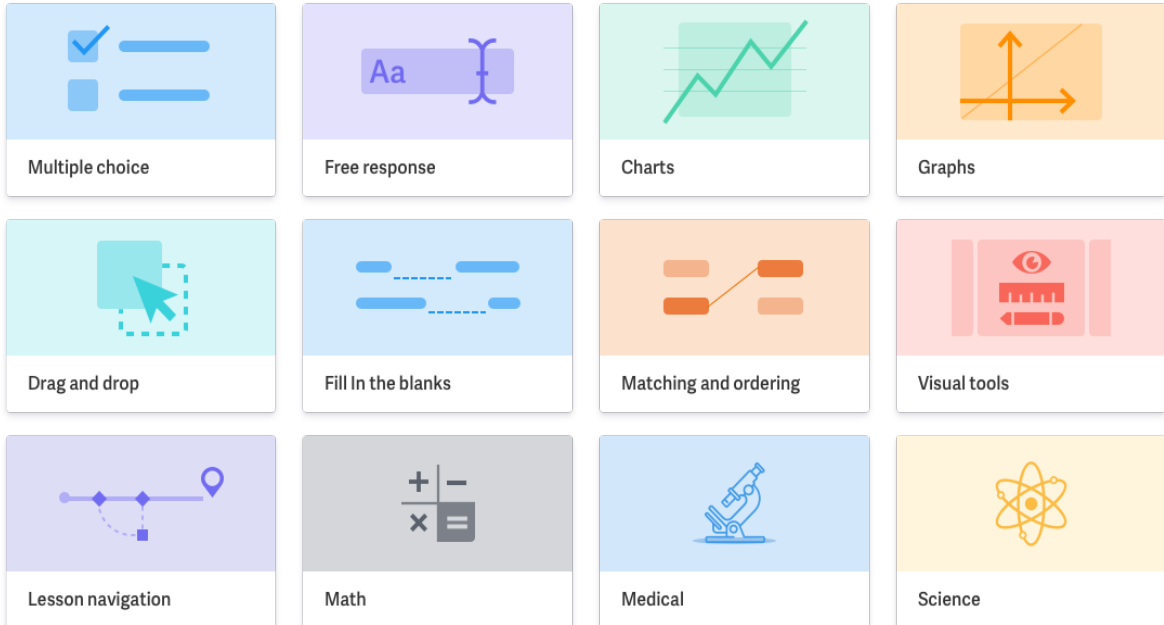
realize**it**

3.Realizeit

It is an educational product of CCFK, a provider of adaptive education solutions for ToB terminal, which was established in the United States in 2007. By providing an intelligent adaptive SAAS platform, a large content library and a professional offline team, it helps educational institutions build a dynamic adaptive education platform.

Business model: profit by providing adaptive education systems, course content, and services to schools, educational institutions, and publishers.

Product analysis: The system records all the data generated by learners, including the length of learning time, the number of attempts and results of each problem, the number and types of interactions between teachers and learners, and external intervention data.

• this system has two key features. One is that when data are not available, the system makes judgments by testing students or content. The second is that the accuracy, efficiency and effectiveness of data are guaranteed when collecting data.

• for students, the system tracks the progress and achievements of each student through continuous data learning, and identifies the degree of knowledge mastered by students, so as to provide personalized and adaptive learning experience for everyone. The advantage of the system is that there is no need to trace the data reported and analyzed, and students' learning situation is constantly updated through real-time dynamic analysis. Data analysis can be used to guide the decision-making of educational institutions, including curriculum setting and curriculum index establishment.

RealizeIt Adaptive Learning system model
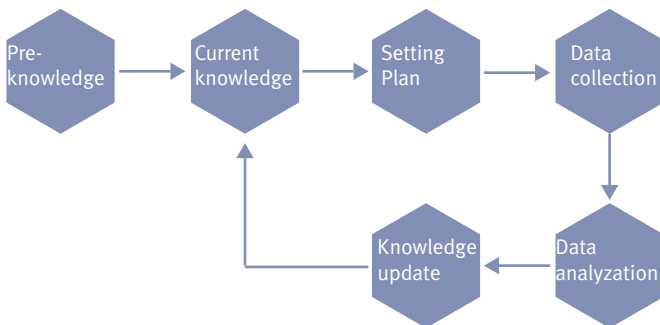
Progressive data

Course feedback guides educational institutions to arrange courses and establish indicators

Analysis of student learning conditions automatically generates feedback on the curriculum

Produce an analysis report through learning analysis to analyze students' learning situation for teachers

Through the integration of several student data to establish a group learning map

Based on the learning data, analyze and guide the students' learning situation and establish the ability map

Conclusion

The case study analysis is aimed at the internationally renowned online adaptive education platform, which involves Knewton, Aleks, Cogbooks, Knowre, Smart Sparrow and RealizeIt. Most of the interface design is similar to video games. To give a specific character image, so that students will empathize when they use it. After each task, the students' behaviors are analyzed. The simple icons are used to indicate the degree of mastery of the knowledge points under the influence of various factors, and then the corresponding curriculum planning and course recommendation are carried out according to the degree. Some of them can be used in the online teaching environment, and the interface is divided into a teacher version and a student version. It can be seen that through the intervention of technology, teachers can devote more energy to interacting with students. All of the above companies are targeting personal use-based learning and have not yet introduced a multiplayer mission model. The game-like learning experience is not very competitive for the products on the market. How to combine the effective and interactive

processes of knowledge points and give the system a stronger ability to grow, that is, how to make according to the transfer of knowledge points. Change accordingly. What students need is an educational system that advances along with their level of learning. The courses they study are diverse but interrelated. In particular, Chinese primary and secondary school students in the context of exam-oriented education, the learning process is for individuals to learn alone, lack of interaction with classmates. In fact, through contact with classmates, you can better stimulate your learning potential.

In the next design, the above will be considered through analysis. It also focuses on the interaction of students in learning knowledge, and the individual individuals in the maker space are combined through interactive terminals.

3.3 Scenario building

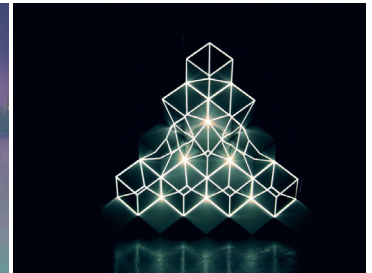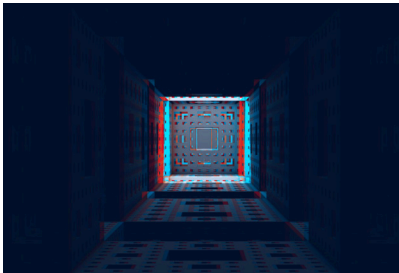TITLE
interactive product terminal

SUBTITLE
"Learning in Space "

DESCRIPTION
-Device as a communication bridge
-Device as an assistant
- Integrate functional space
- Device that shows the course content
- High flexibility, the choice of materials is very important
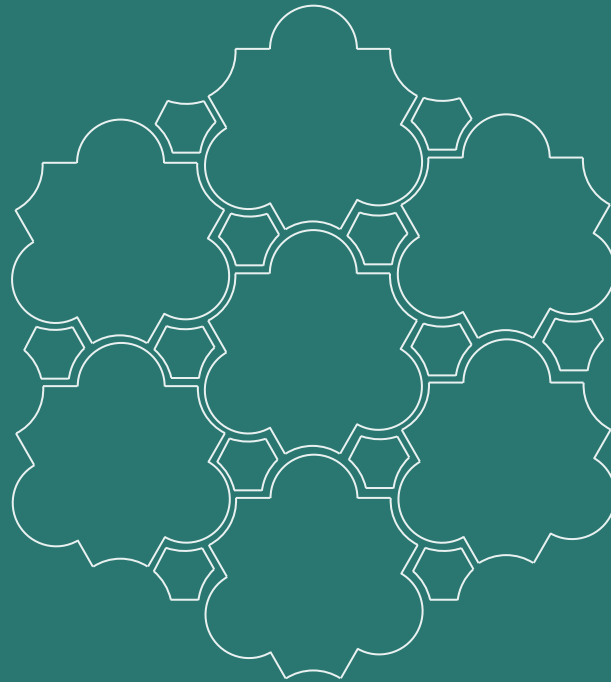- Combined with the environment

POTENTIAL USER
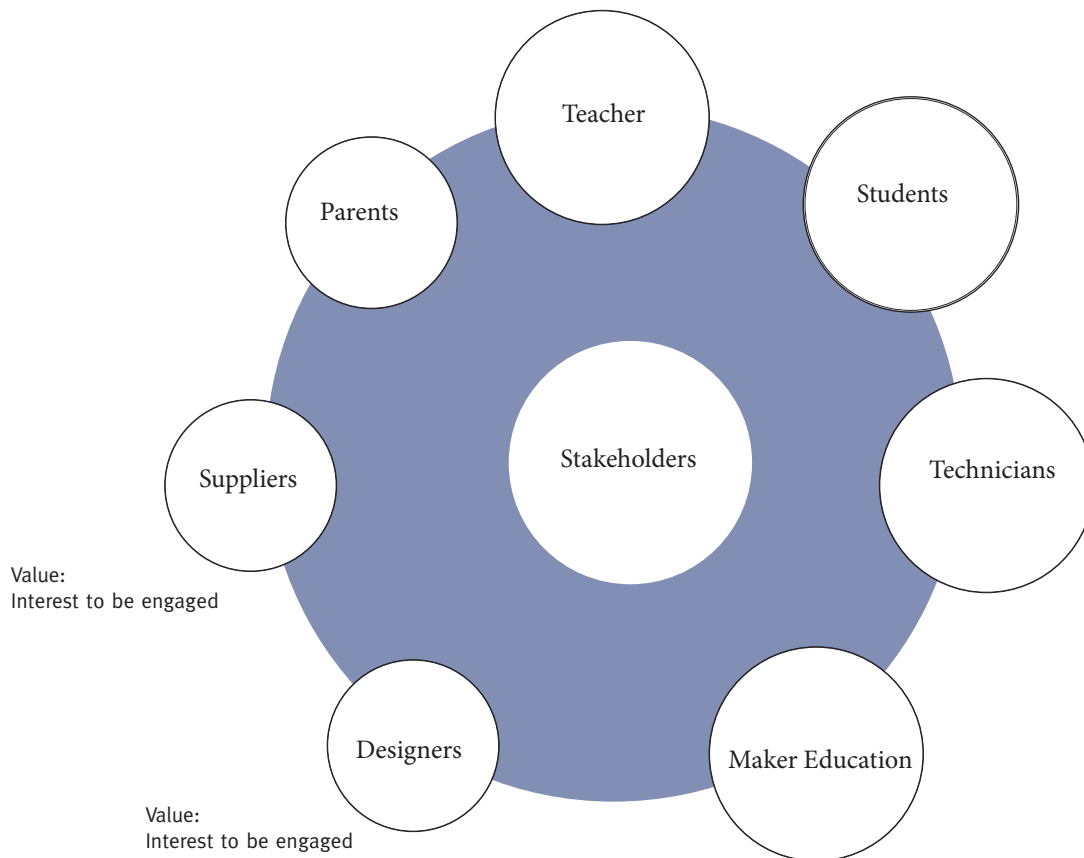Classroom taught in small groups

Atmosphere

Potential User

The perimeter of Borromini's San Carloalle Quattro Fontane,tiled.From Martin Raspe, Das Architektursystem Borrominis (Munich:Deutscher Kunstverlag, 1994)

4.Design Development

Through research and analysis, as well as research on the company's products and how it works in adaptive learning focused on artificial intelligence. Continue to deepen the design, first consider the personnel involved in the various systems involved in the entire system, using design thinking communication technology, social and commercial level, to build a complete process system. Explore the competitive advantage of the system by analyzing the SWOT of the maker space. Apply the concept of Co-Learning to the design, and you can see the preliminary product design at the end of this chapter.

4.1 Market research

4.1.1 Stakeholder map

Value:
Interest to be engaged

Value:
Interest to be engaged

Process & Patern

Technology

Computational Thinking

Technologically
Teasible

Design
Thinking

Match People's
Needs

Vable Business
Strategy

Critical Thinking

Soceity

Ecomomic

Business Thinking

Meaning & Value

Context & Application

Community

Workshop

Lean
Development
ment

Incubator

Partner

Idea

Prototype

Product

Funding
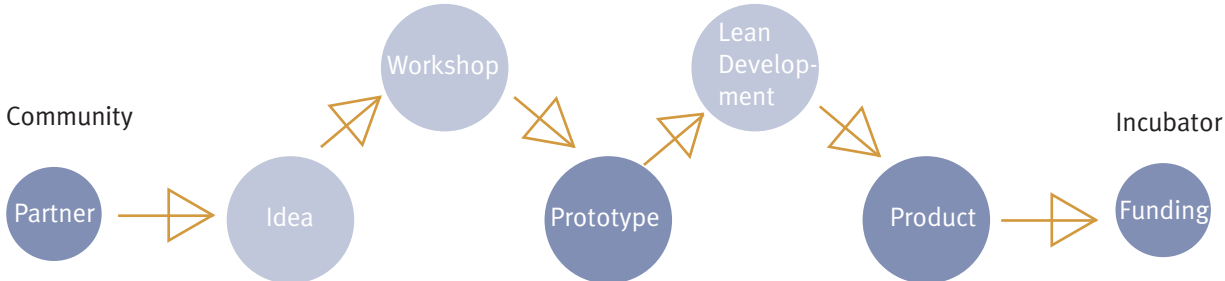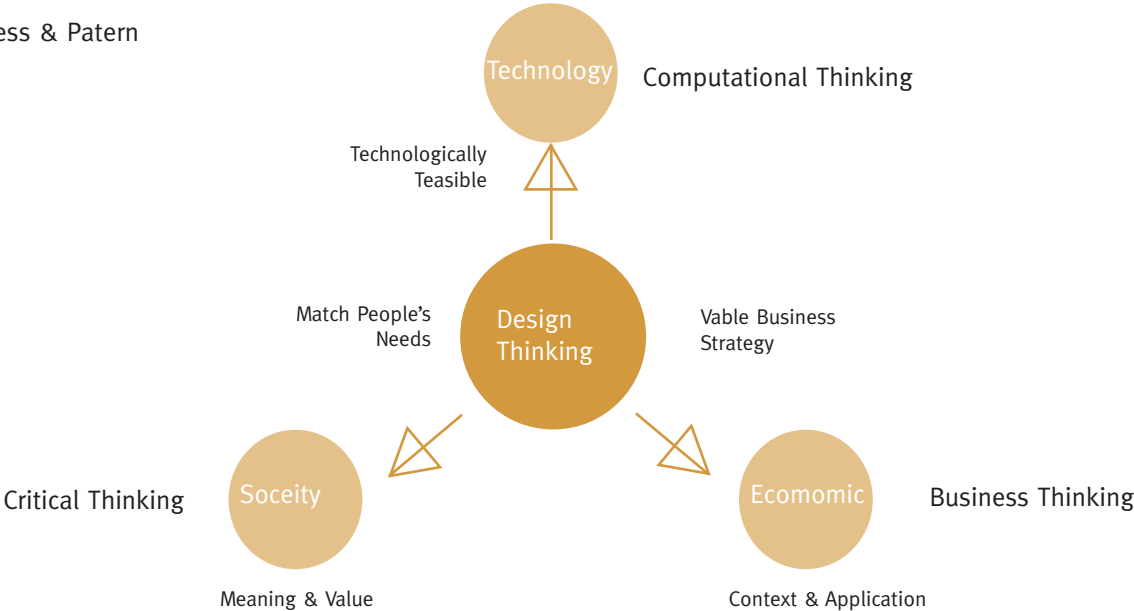
4.2 Problem setting -finding-re-framing

Strength

advanced and educational nature of maker education concept

Weakness

limitations in the implementation of maker education and shortage of teachers

Opportunity

with the support of artificial intelligence trend and government forces

Threats

the industry is in chaos and the enterprise positioning is unclear.
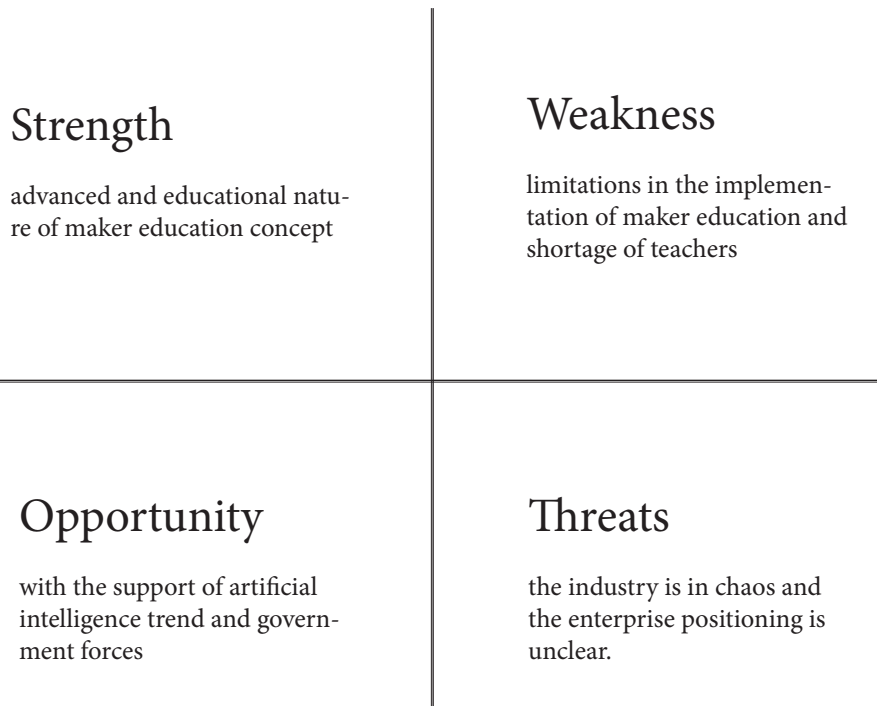
SWOT analysis

Strength: advanced and educational nature of maker education concept.

Maker education is a subversion of traditional education. His concept not only has the pragmatic idea of "learning by doing", but also restored the fun concept of learning, which is a breakthrough of traditional education. "Internet +" and "artificial intelligence +" provide a convenient platform for the development of maker education and help teenagers who grow up in the new era to construct a world view and thinking mode.

Maker education breaks through the routine and allows students to experience the fun of creation in project-based learning. Children can turn the ideas in their heads into reality, which is the embodiment of creativity. Maker education emphasizes action, sharing and cooperation, as well as the combination with new technological means.

Weakness: limitations in the implementation of maker education and shortage of teachers

Maker education relies on advanced information technology, as well as well-equipped space and platform with rich contents. Such innovative space is a challenge to the traditional classroom. Maker education also poses problems for teachers. The content of maker curriculum system is novel and involves a lot of related subject knowledge. However, most teachers have insufficient knowledge reserve and are prone to scientific mistakes when facing actual teaching. Maker education needs to develop excellent teachers to meet the demand of talent cultivation for the future, which is the weakness of the rapid development of maker education.

Opportunity: with the support of artificial intelligence trend and government forces.

The comprehensive arrival of artificial intelligence era has given birth to the development of maker education technology. The Internet has become a big push for the development of maker education, not only alleviating the distribution of excellent educational resources, but also achieving maker education.

Threats: the industry is in chaos and the enterprise positioning is unclear.

Since the development of maker education is still in the initial stage, the problems are also obvious. Maker space is monotonous and lacks features; Market opacity, industrial chaos and other problems are restricting the healthy development of maker education. But on the market today are more mature and curriculum and the robot competition, also should actively explore more areas of the market value is more, in the context of education consumption upgrade, the TO - C enterprise development bottlenecks, the TO - B class enterprise how TO better combine with academic education, how TO - C agency further into the mass market, should be a guest companies such education problem demanding prompt solution. Education, not products, products should serve education, not education for products. How to polish products, optimize the curriculum system, ensure high-quality teachers, and take the refined route is the urgent need of maker education institutions.

	To-B	To-C
Core Competence	Channel and channel control ability	Course quality and business promotion ability
Profit Model	· Teaching AIDS, courses, teacher training costs · For hardware courses, the cost of hardware accounts for half or more	Course fees are the main source of income
Advantage	· Revenue was steady · Under the policy support environment, the management environment is good · With the support of schools, the transition To to-c has certain advantages	· Scale is easier · Market demand leads such institutions to have a higher motivation for curriculum development and a faster ability to iterate courses.
Disadvantage	· Lack of attention to educational content · It is easy to encounter the bottleneck of scale expansion · Channel acquisition is not marketized · The service process lasts for a long time, and the return of funds is slow	· The cost of acquiring customers is hig · Content homogeneity · Revenues depend on the quality of the programme and its marketing

|	On-line	Off-line
Advantage	· It is not limited to any region or space, which greatly increases the convenience of education and can solve the problem of educational resource allocation to a certain extent. · Scale is accomplished quickly	· Inadequate educational resources result in uneven distribution · It's slower to scale · Store cost and operation cost are high
Disadvantage	· The field education of practical operation course is not strong · Training, parents, children three separate, parents experience is not high. Institutions need to put more effort into perfecting the parent experience · Customer acquisition costs are high	· Inadequate educational resources result in uneven distribution · It's slower to scale · Store cost and operation cost are high

4.3 Story board

"Co-Learning Space"

Coliving is a type of intentional community providing shared housing for people with shared intentions. This may simply be coming together for activities such as meals and discussion in the common living areas, yet may extend to shared workspace and collective endeavours such as living more sustainably.

Using this co-living idea to the maker space, this kind of space can be think as classroom but more flexible and interactive. Not only the desk, the chair, but also the other equipment to assist your action.

synergy

Interaction

Feedback

Output

Input

Data

Customization

Manage
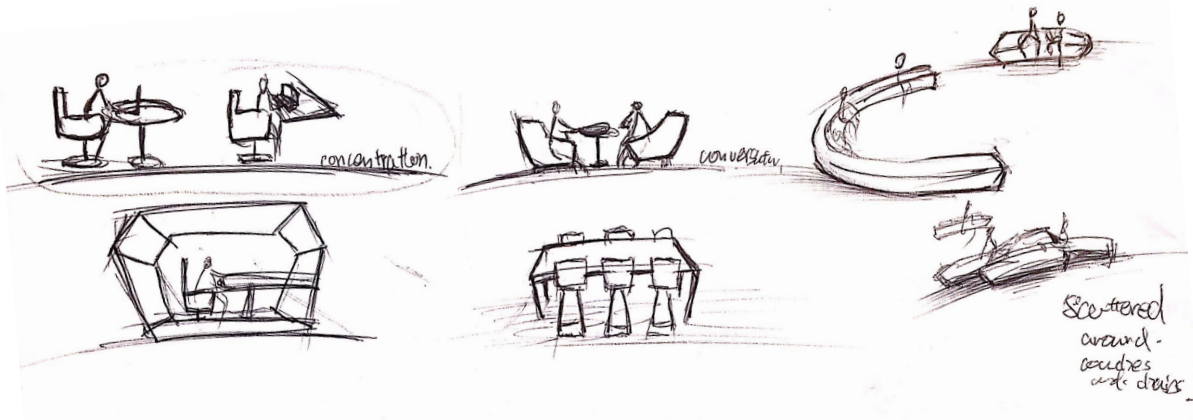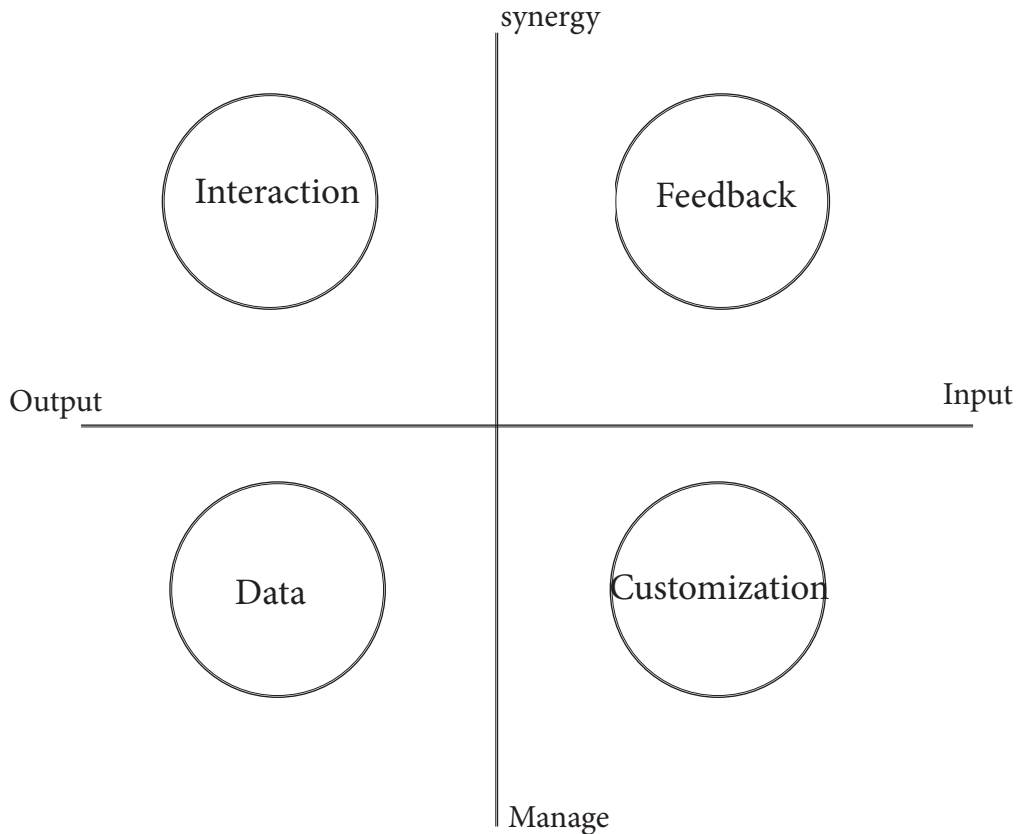
Trying to define this kind of device in makerspace from 4 aspects to analyse. Behind these key words is the original expectation about what function and convenient can be provided for the users. In the previous chapter I point out that in 21st century everything turns to data, with the development of the technology, by analysing the data we collect we can soon get the answer correctly and efficiently. There are already numerous kinds of interactive device in public area, what

we can use this data for? Not only for the research result, but also for the participants themselves. In teaching area especially in China this kind of country which has a large number of population, a classroom normally accommodate around 60 students, with the help of AI teacher will have more time and patient to each student, teacher will see everyone's progress and give the positive feedback in time. These real time reaction will enhance the communication between teacher and students.

4.4 Mood board

An interactive product terminal in the maker space that integrates teachers and young makers. Controlled by the teacher, the student can be followed up to record the acceptance of the course content, and the related teaching aids can be connected to the terminal. Through the AI algorithm to analyze the time and proficiency of the students to complete the course tasks. The teacher can adjust the course progress according to the AI data, and can adjust the teaching content by comparing the data of each batch of students.
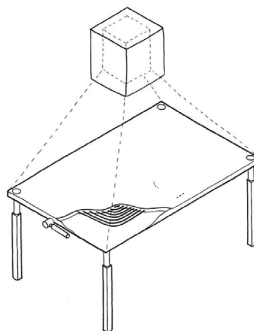
Designing the Future Kitchen
How we will cook, eat, and socialize at home   -IKEA

4.4 Mood board

4.4.1 Environment

4.4 Mood board

4.4.2 Makerspace furniture design

01 Natural
- link to nature and sustainability
- natural forms

02 Warm
- pleasant haptics
- opposite of cold computer cases

03 Organic
- natural space within reach
- no grids

04 Clean
- no wires
- tidied up

Look & Feel

Usability

01 Easy Maintenance
- for electrical parts
- digital & physical updates

02 Adaptive
- customizable to need & costs
- mobility
- flexibility

03 Intuitive
- form & function
- CMF

From Johannes Kepler,Harmonices mundi, book 5(Linz:Gottfried Tampach,1619)

5. Final Design

The final design is presented as a set of interactive terminal product designs and corresponding interface designs for the maker space. The product design includes a terminal body that can be easily understood as a desk combination. By building it can be assembled into a desk frame with lights and projectors at the top of the shelf. The side of the shelf can add accessories such as whiteboards for teaching needs. The desktop can be adjusted for the purpose of the teaching and the height of the student. The projector at the top of the shelf can put the relevant interface on the desktop. When the student completes the installation of the programming robot, the robot can be placed on the surface, the projector is turned on, and the learning point is started according to the interface indication projected on the desktop.

5. Final Design

Makerspace funiture design

GUARINIAN MAKERSPACE SYSTEM
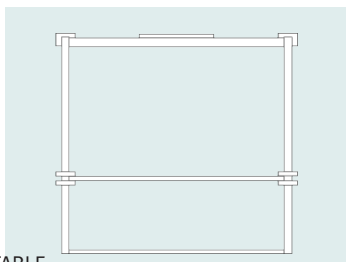
TABLE
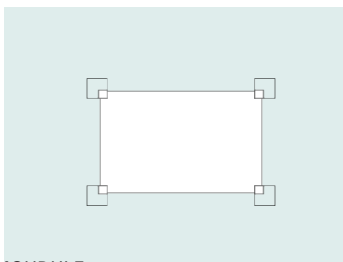
MOUDULE

VIRTUAL PROFILE

LAYOUT

PERSONAL WORKSPACE

3D PRINTING

RELAX & SOCIAL

CO-LEARNING
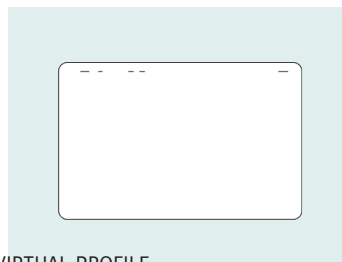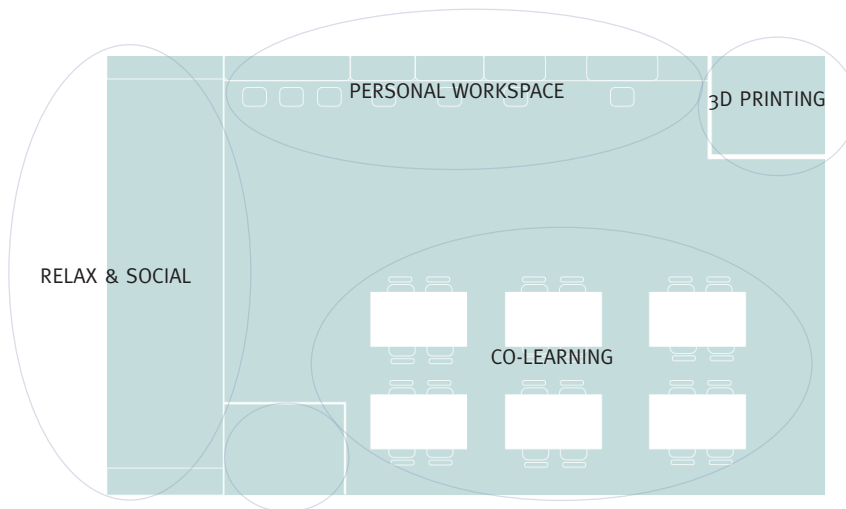
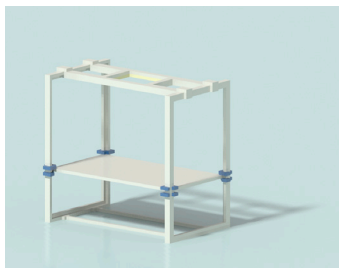## BLUR THE BOUNDRIES BETWEEN FURNITRURE AND TECHNOLOGY
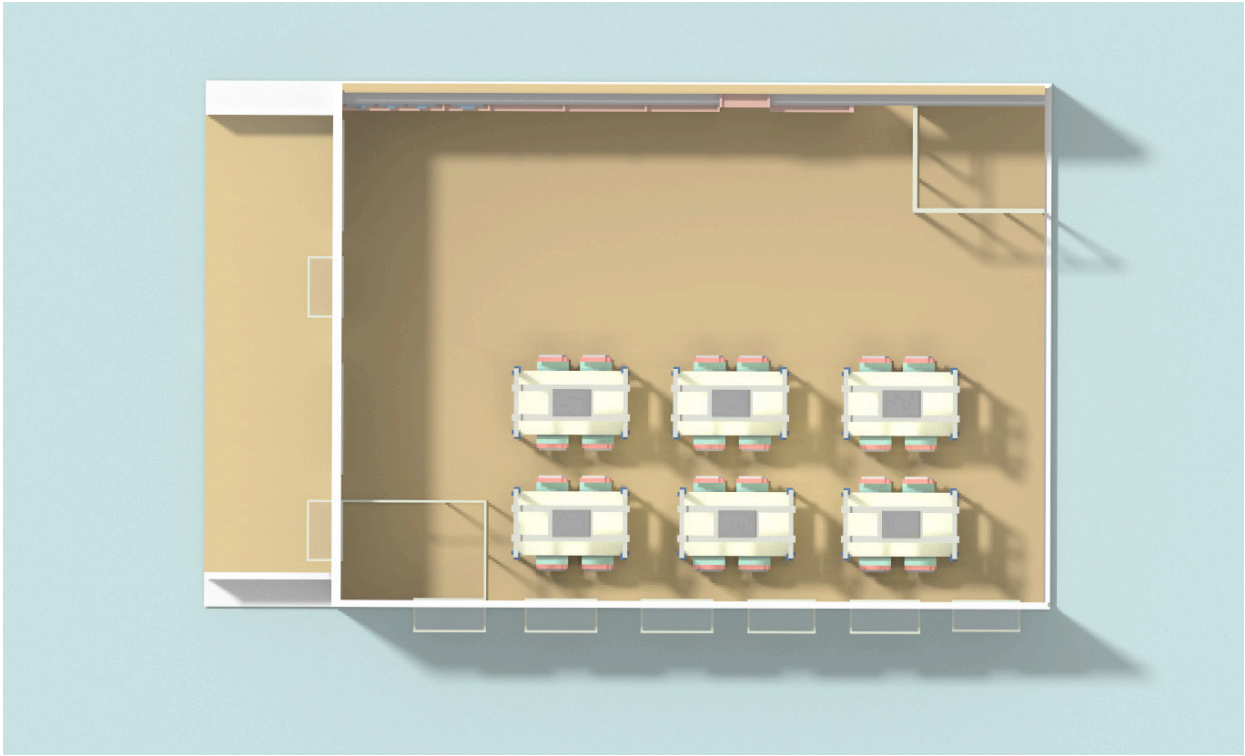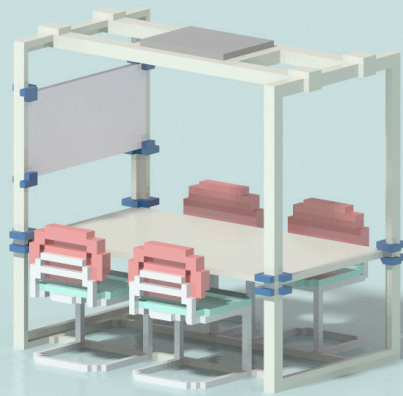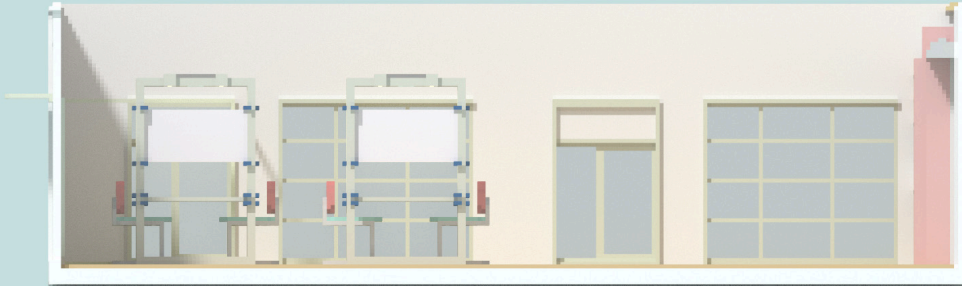
Guarinian

Interactive Terminal Product

Step 1

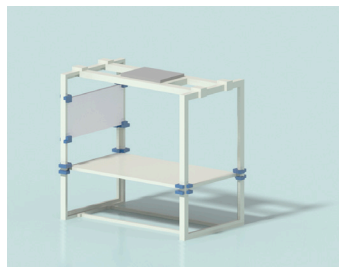Setting the fram of Guarinian Interactive Terminal Product.

Step 2

Using the fasteners to secure the table to the right position and adjust the height to the height of the student.

Step 3

Installing the projector at the top to fix its position, adjust the projector parameters by the projection size on the desktop.

Step 4

If necessary, add whiteboard and other learning accessories on the side of the framwork.
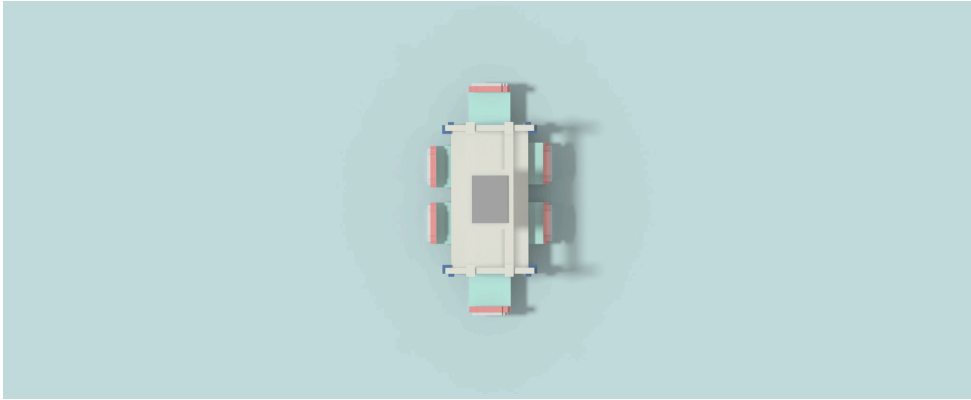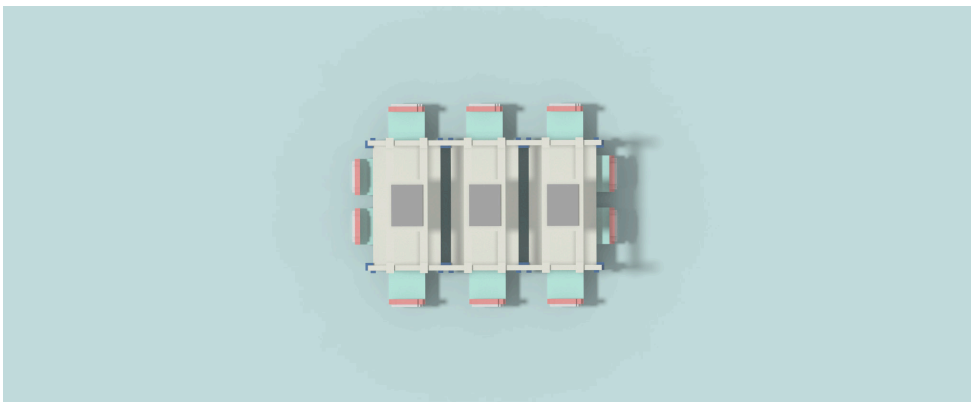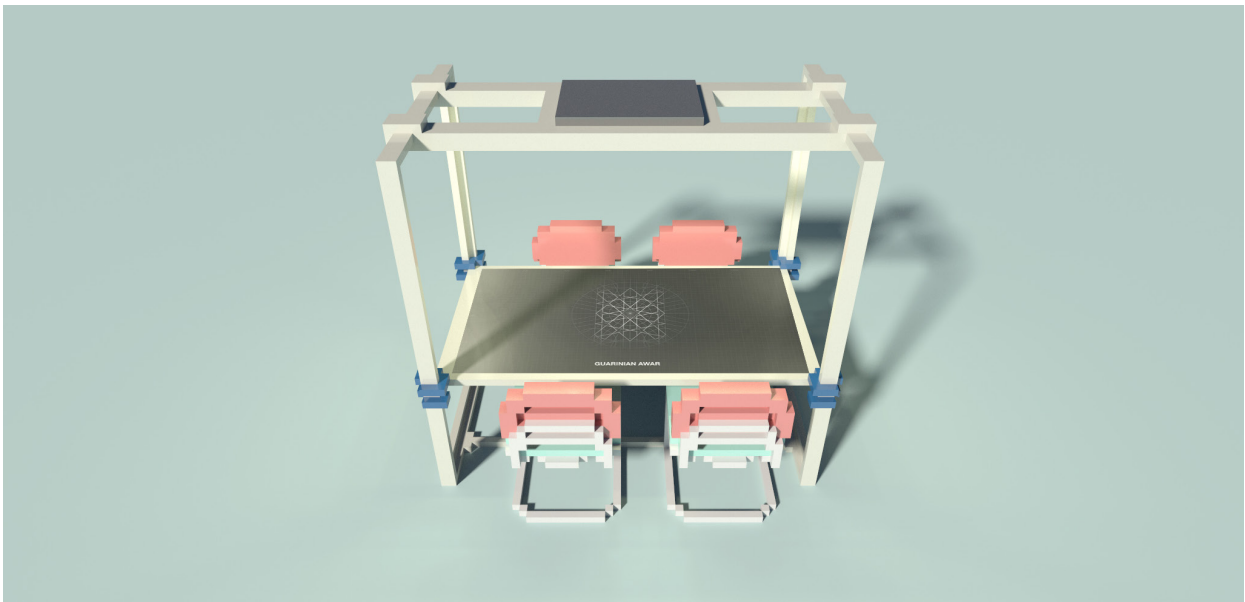
Table: 1
Students: 6
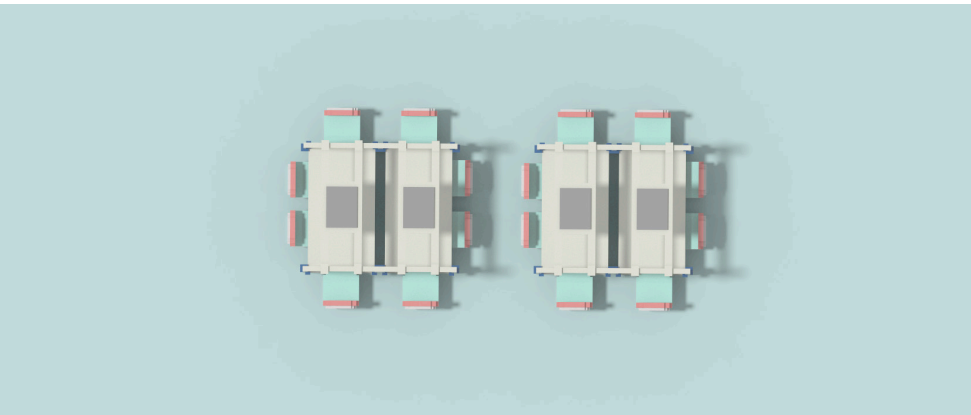
Table: 2
Students: 8

Table: 3
Students: 10

5.3 Interactive Terminal Product Interface Design

Interface design of the "Interactive Terminal Product for Guarinian" getting the inspiration from the most significant project of Guarino Guarini. Here shows the first example of how it works, using the structure of The Chapel of the Holy Shroud designed by Guarini and built at the end of the 17th century , which is a Baroque-style Roman Catholic chapel in Turin in northern Italy. Located outside the Turin Cathedral and connected to the Royal Palace of Turin. Divided this chapel into 3 layers and each layer represent a game level, by challenging this game, Guarinian can

have a better understanding of the design thinking of Guarini as well as learn basic knowledge through the game.

Behind the design of the game route is the basic mathematical knowledge. Through programming, the path robot moves in the specified direction to obtain the integral, which involves polar coordinates, two-dimensional coordinate axes and arcs. Adding fun to math operations, visualize calculations and increase student enthusiasm about learning.

Credit foto Daniele Bottallo
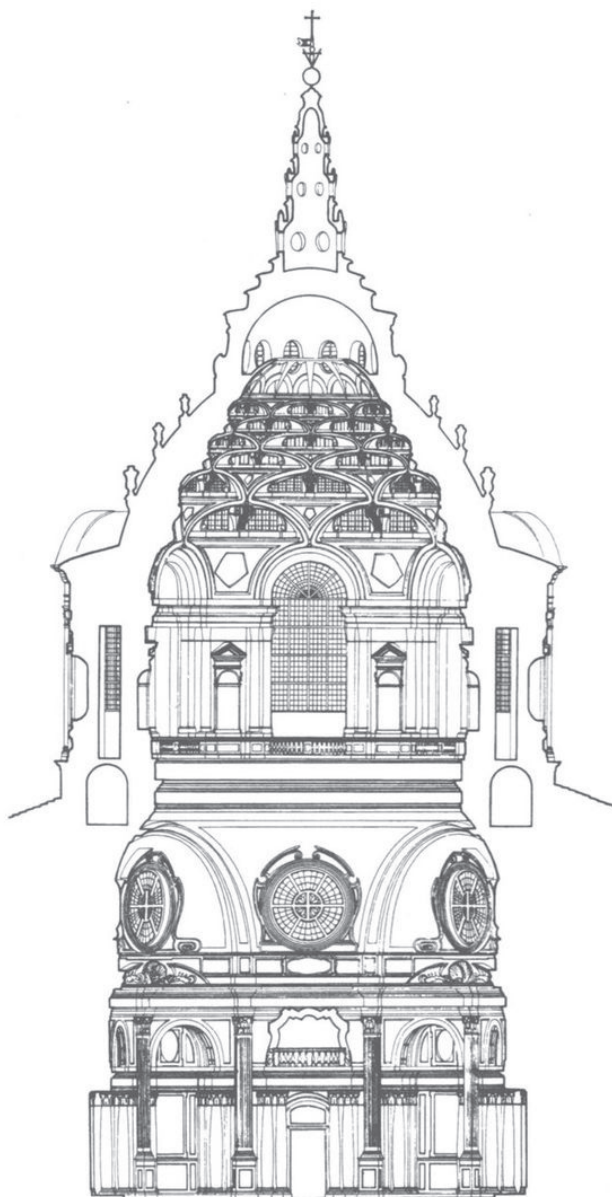
Level 3

Level 2

Level 1

Chapel of the Holy Shroud,Turin,section,from Passanti 1963.(GAMT)

Round 1

1. Inspiration from Guarini

Credit foto Daniele Bottallo

2. Design Description

The first level begins at the bottom of the building's interior and is shown on the floor inside the sindone. After entering Sindone, you can see the hexagonal star laying on the ground, and the internal ground is marked. When the sun is launched from the top of the church, as the earth rotates, the sun moves and the illumination is at a specific position to accurately indicate the current time.

The hexagon is extracted as the core element of the first off,

and the twelve hexagons are evenly arranged on the circumference. Simulating the change in the orientation of the sun through the church, the hexagonal star lights up, and the robot is controlled by the path to reach the illuminated hexagonal star to complete the challenge. In the game, you can understand the orientation, which is also the polar coordinates that will be touched after the advanced.
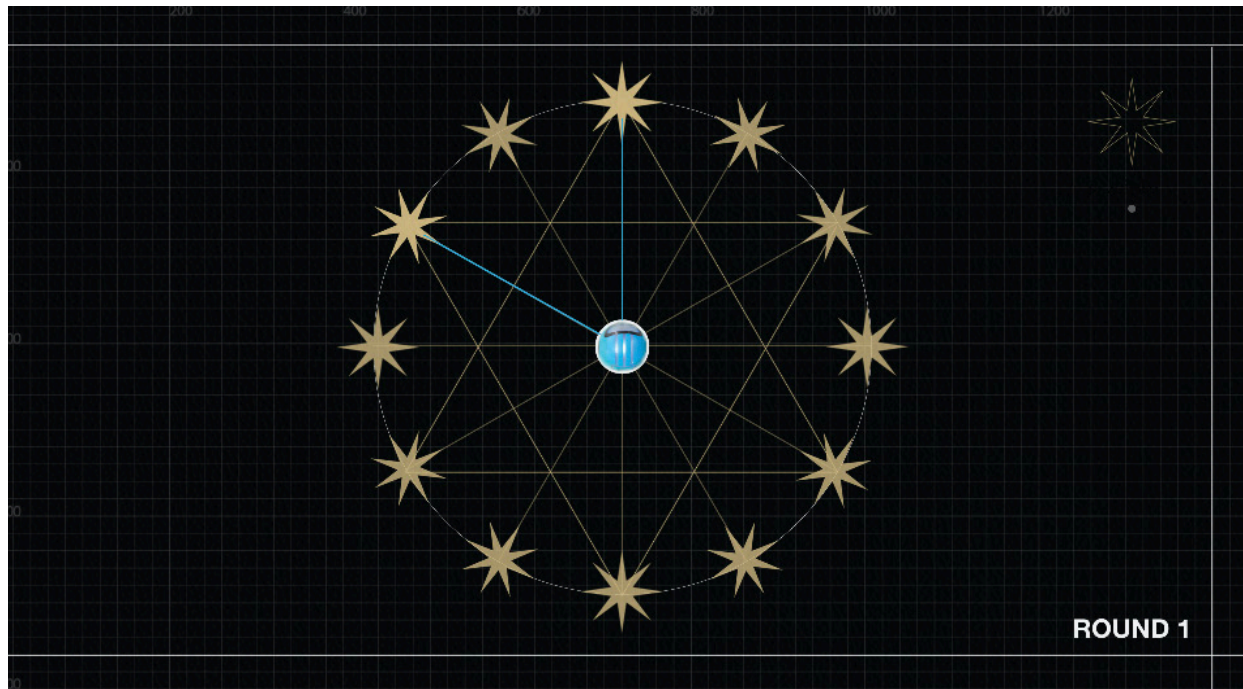
3. Interdace Detail
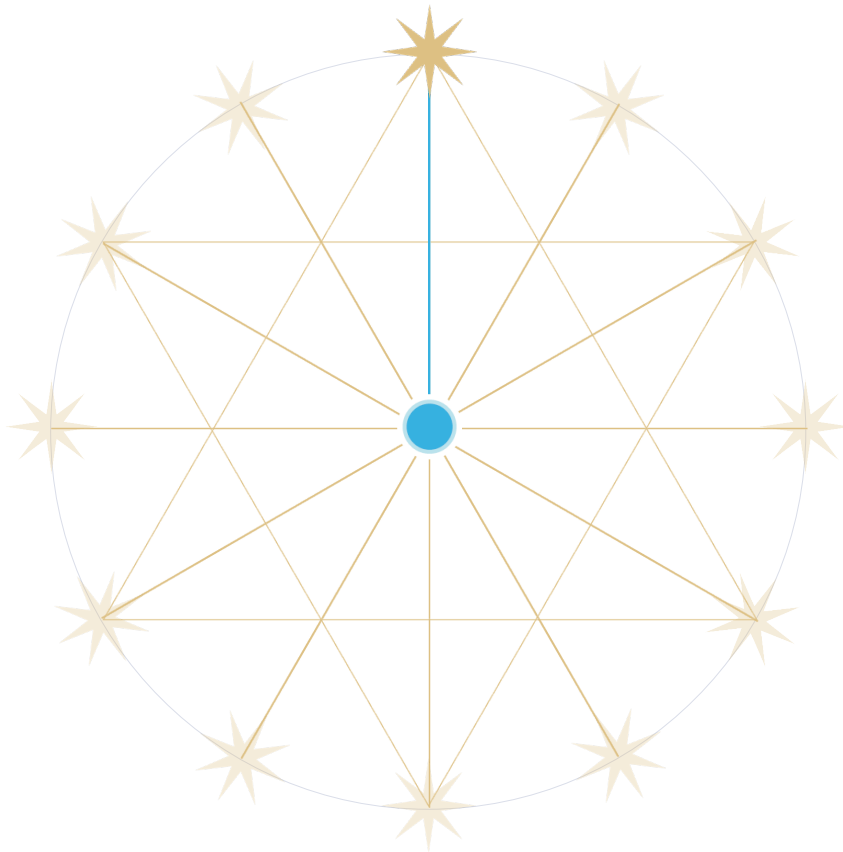
Plan the path when the yellow hexagonal star lights up, allowing the path programming robot to arrive at the origin to earn points
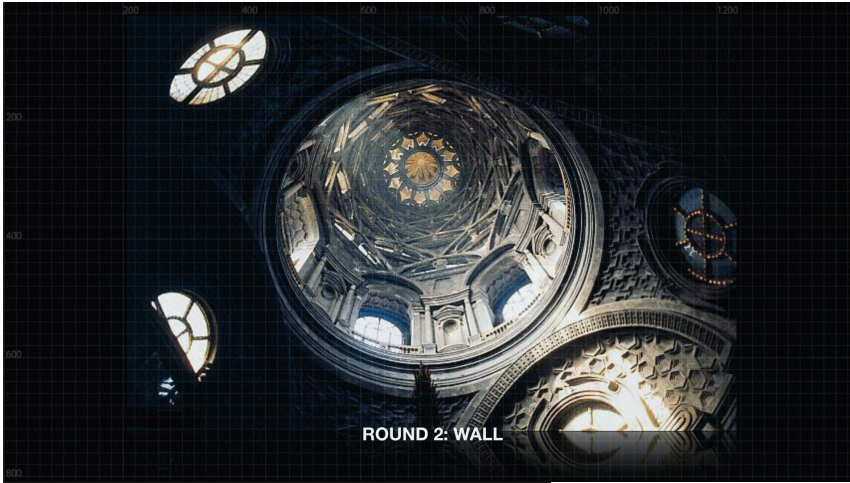
Plan the path when the yellow hexagonal star lights up, allowing the path programming robot to arrive at the origin to earn points
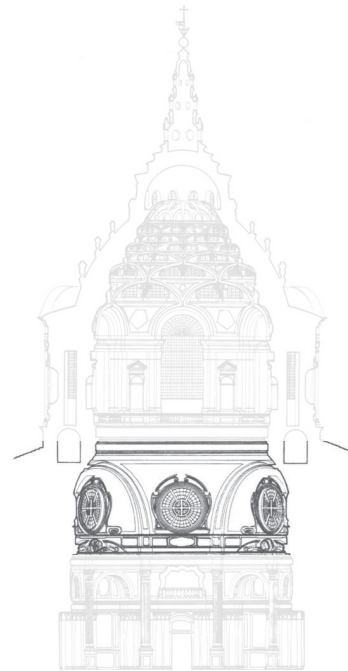
ROUND 1

Round 2

1. Inspiration from Guarini


ROUND 2: WALL

Credit foto Daniele Bottallo

2. Design Description

Everywhere one looks in the Shroud Chapel, circles, triangles, pen-tagons, hexagons, and other geometrical forms appear. For the most part, however, these are not symboling in the sense of traditional iconography but serve instead as indicators of the architect's procedure. For Guarini, geometry "teaches how co deploy the numbers of the intellect by means of a certain kind of argumentation that pem₁its the discovery of other truths" (1665, 179). Geometry thereby becomes a procedure that harmonizes the necessary pares of a design into a whole according to their own natural relationships (Tavassi La Greca 1968, 450--52). Geometry occupied a major place in seventeenth-century Euro-pean in-tellectual culture, not only in the realms of science and philosophy but also in art. Architectural design in general and Guarini in particular share this characteristic of the period.

Extracting the pattern on the facade arch at the second level can be considered as converting a 3-dimensional image into a 2-dimensional image. The pattern group combines the hexagon with the hexagonal star to create an array pattern, and the coordinates of each star are determined by the xy axis to calculate the distance the path robot has to move on the xy two axes.

3. Interdace Detail
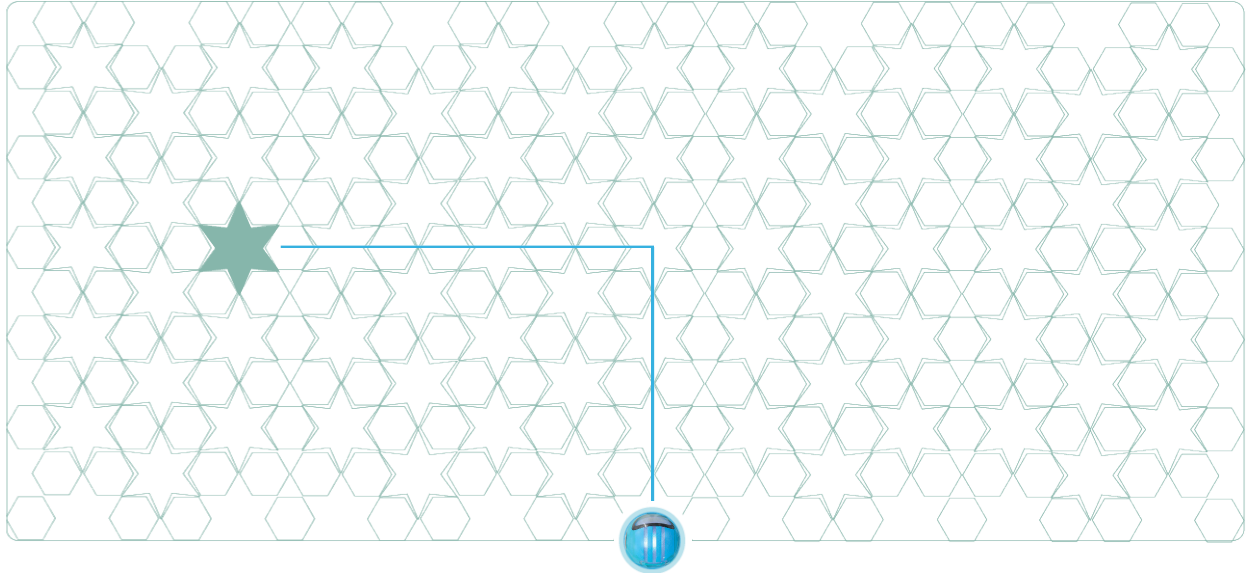
Plan the path when the green hexagonal star lights up, allowing the path programming robot to arrive at the origin to earn points

Plan the path when the yellow hexagonal star lights up, allowing the path programming robot to arrive at the origin to earn points

Difficulty upgrade:

Compared with the first level, the second level increases the angle setting, that is, the path robot needs to turn when walking, and has a certain understanding of the left and right direction during the game and has an understanding of the coordinate axes to be learned in the future.
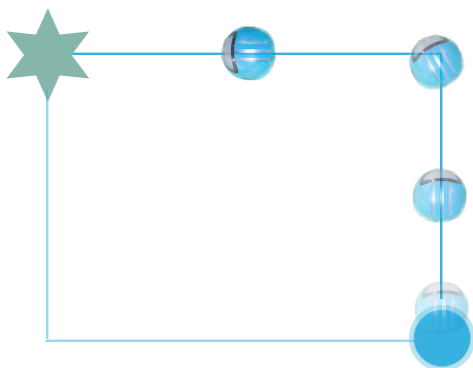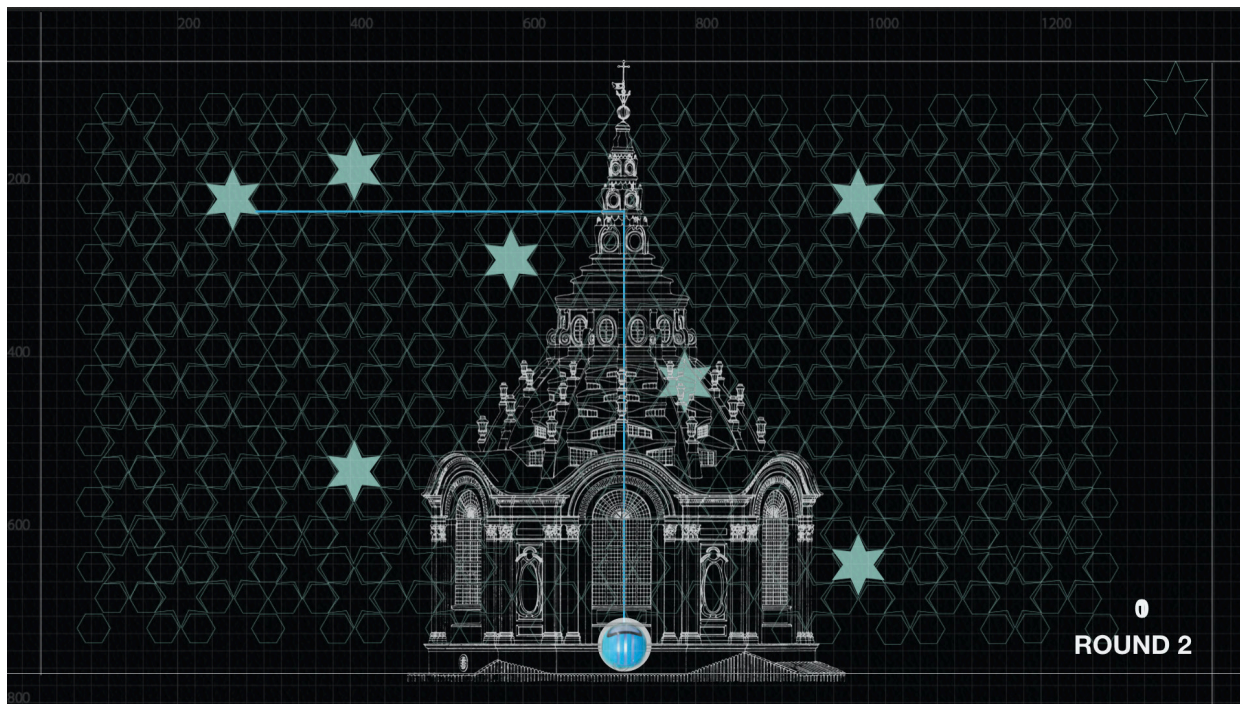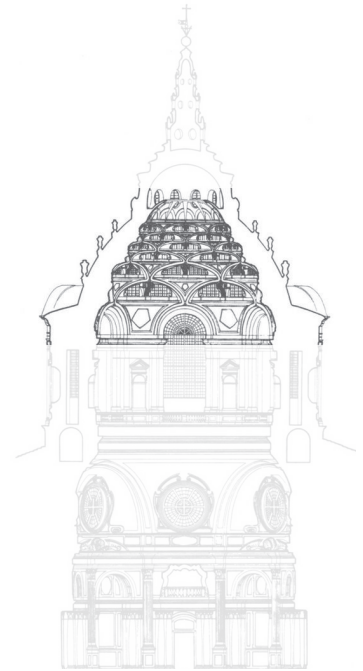
Starting from the origin, we must first judge whether the target star appears on the left or right side. As shown in the figure, it is the easiest and fastest way to arrive. You can also choose more paths to arrive. Try how many different ways you can give.

Round 3

1. Inspiration from Guarini


ROUND 3: VAULTING

Credit foto Daniele Bottallo

2. Design Description

Guarini employed several mechanisms to achieve the illusion of in-creased vertical extension. We have already noted how the diminution in the diameter of each successive hexagonal tier produces the psychological effect of exaggerated height. Reinforcing this illusion, Guarini added a serpentine torus molding that runs along the fasciae of the ribs. This feature begins along the voussoirs of the drum windows and winds its way upward through the dome proper, turning back just at the crown of each ellipse and above the console dividing the window in half and masking the underside of the exterior buttress. The subtlety of the effect is such that the viewer hardly notices it from floor level, but the device leads the eye ever upward toward the luminous openwork star that crowns the series of hexagons. To emphasize this device, Guarini exaggerated the element in the Disse,Rni engraved section. Beginning at the drum cornice level the torus meanders toward the top tier and then loops over to descend back down to the level whence it orig-inated. Although the molding may operate barely at the conscious level of the observer, it visually binds together the series of stacked tiers and thereby strengthens the sense of towering recession.(Architecture for the Shroud Relic and Ritual in Turin, John Beldon Scott)

3. Interdace Detail
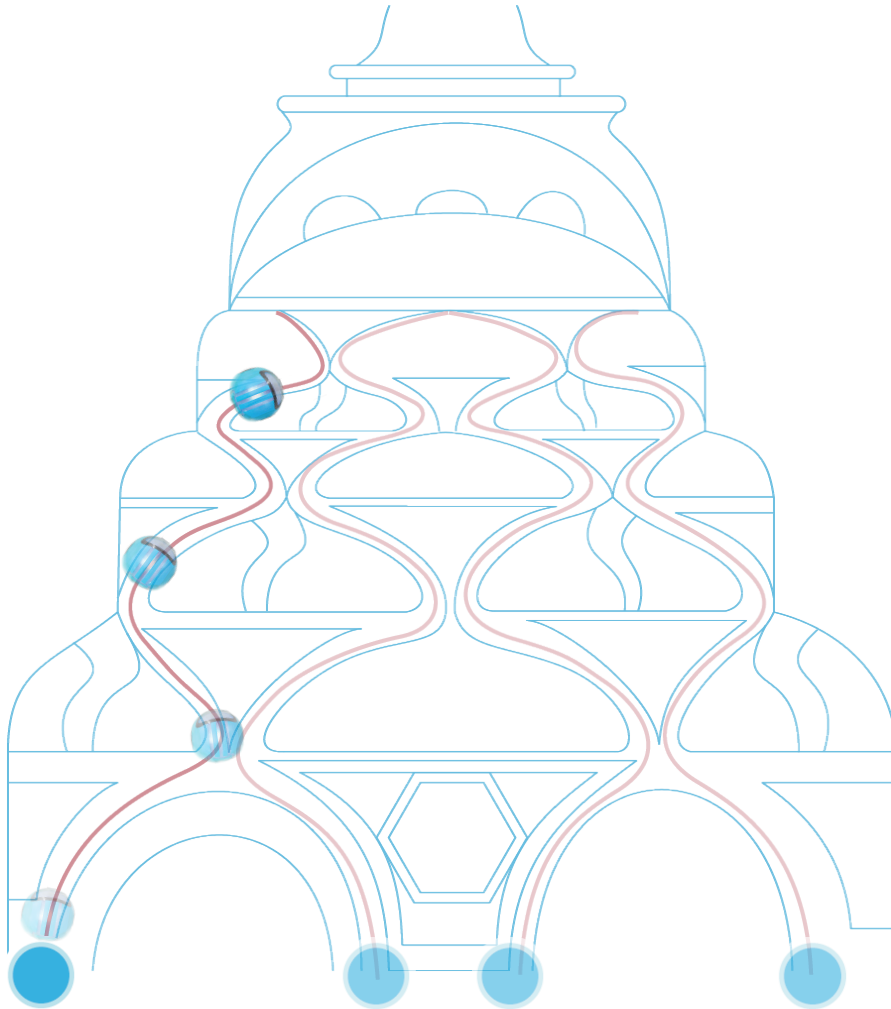
Cupola with torus molding superimposed in red, Chapel of the Holy Shroud.
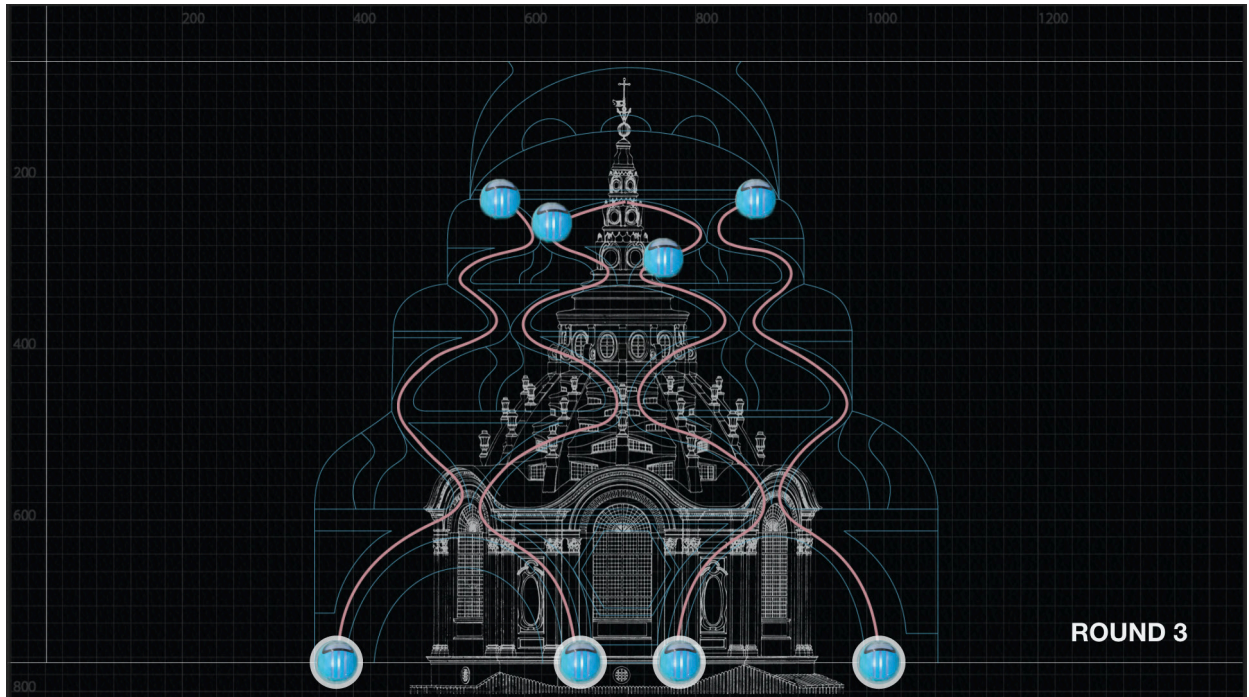
The third level has a single-player mode and a multi-player mode. It is a review and promotion of the first two levels of knowledge points. The route shown in the figure is the curve outside the Sidone.

In multiplayer mode, you can start the game with multiple friends, and see who gets to the top of sindone to complete the challenge.

GUARINIAN AWARD

5.3 Value and effect

1. Using AI technology to assist teaching is a way to solve the shortage of teachers and reduce the cost of teachers

2. From the outside to the inside: take "realizing communication" as the entrance and "exploring the world and self" as the exit the value system of children's programming industry presents the

form of progressive inverted triangle, divided into four layers of progressive relationship:

(1)The first layer is more concrete and easier to understand. Programming learning actually builds a bridge to communicate with the computer. By learning programming knowledge, the

operation is carried out to understand the logic behind the computer, and at the same time, children's thinking logic is also exercised.

(2)The second layer is closely built on the first layer: all aspects of the era of artificial intelligence will be empowered by AI technology, so people need to have similar "computational thinking", so as to have a deeper and more intuitive understanding of the society in the era of AI;

(3)The third level is to stimulate the desire to explore the world independently. The development of technology in the future will make the acquisition of knowledge no longer difficult.

(4)The fourth layer is a relatively more valuable one: programming will help children build their own virtual worlds in the computer. Children learn to program and then know the process of computer, which is actually to explore and express the process of their own way of thinking.

Using the power of technology to enhance the enthusiastic of studing will benifit both studenta and teachers. Guarinian interactive terminal product system is not only an assitant for teaching but also a bridge between the teacher and students. By using adaptive learning based on AI, no matter how many students, each of them is unique, parents don't need to worry about neglection happen in their kids. Teacher can take care of all of them due to the data analysing in real time.

Advances in technology do not presage the decline of human communication. Instead, we should believe that technology is a medium that helps us communicate with the past and the present. Complex data processing systems are more advantageous than human processing in dealing with multiple variables, and each particular individual can obtain the most appropriate teaching plan through data analysis. In the offline teaching

Share

Cooperation

Stimulate

Copy Extend

State

Copy

Story
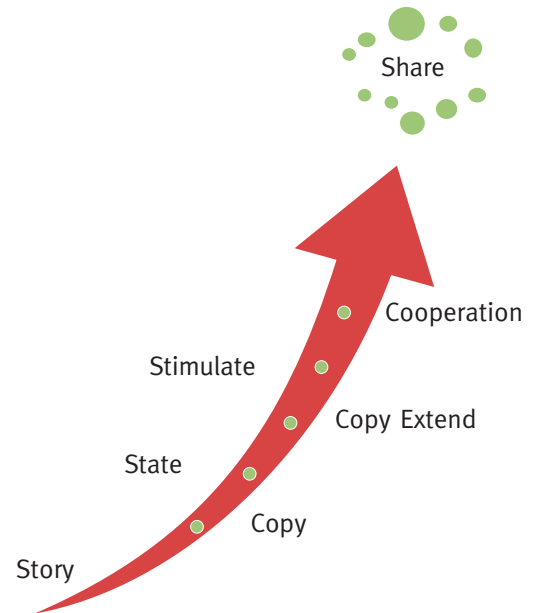
environment, the communication between each student can further expand the child's cognition, and hope that the interactive terminal system can bring a better learning experience for students and teachers.

6.SUMMARY

The above is the complete content of this thesis. From the original Italic concept, I was exposed to Guarino Guarini, a well-known 17th-century scholar in the history of Italy. Smart italic is a very research-oriented topic. As a foreign student, I can better understand the Italian culture through this topic. In particular, through the active 17th-century Italian religious environment of Guarini, architectural art style and research achievements at the scientific level. Cultural output is a project that every country has been striving to develop in recent years. Through the experiences and thoughts of famous people in different historical periods, the keywords representing this character are extracted, and then the modern people with similarities are awakened. Use this feature as a connection medium to communicate the past and the present, and to overcome the obstacles of time and space. Attracting more young people to inherit the classics and discovering their own potential is the goal that this topic hopes to achieve.

The process of research at the beginning of the project itself is, to some extent, a very vivid Italian science curriculum. Since Guarini lived in the 17th century, it has been four centuries since, and encountered many difficulties in searching related materials such as language and cultural background. I would like to thank Marco, the original research groupmate, as an Italian who has a very wild range of Italian knowledge. From religious belief to Baroque art style, every time we communicate with each other, I will have a deeper understanding of this subject. I would also like to thank the professors of Synthesis studio for their patience, especially my tutor Prof. Fortunato D'Amico. Every review is like the popularity of Italian history, and the professors show their profound knowledge and academic conservation. Most of the students are international students from all over the world. Everyone use this topic to understand the Italian style from the educational background of their country, and investigate the historical figures to be studied like a detective. It is a brand new design experience. In the past, most of the projects were based on the search for problems and looking for users. Most of them are a group. The research target of the project is a concrete reality. He has a unique personal charm and a real growth background. Through the external factors such as the thoughts of the characters he touches and the environment of growth, it can help us to deeply understand the way of thinking in his projects.

The potential users of this design are designed for the interactive product terminal of the maker-space in Beijing, China. This terminal coordinates the communication of teachers and students in the form of intelligent teaching assistants. Thanks to Li Yin, CEO of QC Education who helped in the research process, and Professor Fu Zhiyong from Tsinghua University. They have extensive experience and unique insights in China's maker education and artificial intelligence. They have provided a lot of advice and guidance for my thesis. The process of graduation design is full of challenges, although pressure is often felt but it is also a stage of rapid progress.

It is a great honor to learn more about the fascinating culture of Italy in this way. I hope that more people will participate in this cultural exchange project in the future and promote cultural exchanges in various countries.

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