elevBeat! An AI-based lifelong learning system

Student: Ruoshi Yang

Laurea Magistrale - 850953

Supervisor: Lorenzo Ruggieri

Politecnico di Milano
Scuola del Design
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To the better world
The project aims to design a new service system for lifelong learning with Artificial Intelligence as support.

In recent years, personalization and intelligence become trendy from different services. From listening to streaming music with Spotify, watching a movie with Netflix, buying stuff from Amazon, and asking anything to Alexa, Artificial Intelligence impact more and more experience of different services. On the other side, education always a promising industry, and e-learning not a subject from the future anymore. It’s already here now. More and more platform appears on the internet and enters the market. However, there still isn’t existing a service platform which could provide an engaging, rich content but personalized experience to the users. So in this thesis, I would like to discuss how AI this new technology can help improve the experience of lifelong learning. So instead focus on the children, the project focus on young adults and adults people.

The whole project used a design thinking methodology, but because of its technology as the main theme, I started with desk research to have a solid theoretical background. Then with different design phases, I got the main wireframe pages as an outcome. This project is just conceptual, so it has never been implemented. However, I think it’s a very good starting point for observation for the future tool and how it could apply to a traditional topic.
Il progetto mira a progettare un nuovo sistema di servizi per l’apprendimento permanente con l’Intelligenza Artificiale come supporto.


L’intero progetto ha utilizzato una metodologia di design thinking, ma a causa della sua tecnologia come tema principale, ho iniziato con una ricerca a tavolino per avere un solido background teorico. Poi, con diverse fasi di progettazione, ho ottenuto come risultato le pagine principali del wireframe. Questo progetto è solo concettuale, quindi non è mai stato realizzato. Tuttavia, penso che sia un ottimo punto di partenza per l’osservazione dello strumento futuro e di come potrebbe essere applicato a un argomento tradizionale.
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1. INTRODUCTION

1.1 Starting Point

It was just a typical day. I opened my Spotify and directly went to “Discover Weekly” which is a playlist Spotify just generated for me. I played it, and at the same time, I started to browse online and then began to work. It passed 3, 4 songs, I started to feel every piece of music were in the right mood. Then my friend asked me, “what’s the name of this song?”

Eh…wait? What is the name of this song? Or what the name of the last one? I do not remember any of them. However, just back to 15 years ago, I cherished every album I had. Before buying a music album, I would read every single word and understanding everything behind, and then I decide to buy it. Yes, and I listened to it carefully, for every piece. Then technology made everything changed. Streaming makes every piece of music so easy to access; artificial intelligence and machine learning make me skip the process of decision making, and they only leave me listening and enjoy the music. I cannot judge it directly if it is a bad thing or good. Nevertheless, they made the experience more fluid than before, and the service became more convenient for sure.

So why this kind of workflow cannot apply in education? That was my following question—especially the learning topic for the adult. For adults, learning is an autonomous action. What to learn and how to learn have more freedom, but at the same time, learning also becomes an action without a clear guideline.
According to Wikipedia, lifelong learning is "ongoing, voluntary, and self-motivated" pursuit of knowledge for either personal or professional reasons. Therefore, it enhances not only social inclusion, active citizenship, and personal development, but also self-sustainability, as well as competitiveness and employability."

Research shows that lifelong learning is good for health, wealth, civic engagement, and family’s prospects. It prolongs the independent life and enriches our life quality.

For companies, encouraging their employee to learn more make sense, too. In essence, from soft skills such as problem-solving, teamwork, flexibility, and creativity, it could also promote an increased sense of value among staff, making them happier and more productive. These are, of course, some most important factors companies should take into account.

For governments, supporting learning in later life helps to delay the onset of dependency among rapidly aging populations; plays a vital role in overcoming inequality and exclusion; and supports inter-generational learning, creating more resilient families and communities. More broadly, learning fosters improved well-being.

So, as a result, how to use artificial intelligence to enhance the lifelong learning experience became my starting point.
1.2 Design Process

design Thinking is a methodology problem-solving and solution-focused. It is an iterative process in which designer get into the phase to understand the user, identify the problems, and find alternative strategies and solutions which are differentiated from an initial level of understanding. It is a way of thinking which can tackle complex issues with the human-centric mind. And it also can be a useful guideline by adopting a hands-on approach in prototyping and testing.

Understanding the method of Design Thinking will empower anyone to apply it to solve complex problems that occur around us: for the business, nonprofit organization, and even our country and planet.

In the 1969 seminar on design methods, Nobel Prize laureate Herbert Simon generated one of the earliest formal models of the Design Thinking process, which influenced widely some of the most commonly used Design Thinking process models today. He described it as “The Sciences of the Artificial.” This model is prescribed by seven major stages, each stage with its component and activity corresponding.

According to Herbert Simon, the seven stages are:

- Define
- Research
- Ideate
- Prototype
- Choose
- Implement
- Learn
Based on this first model, there are several versions of the design thinking methodology in use today. According to the Hasso-Plattner Institute of Design at Stanford, the leading university in teaching design thinking the five stages of design are as follows:

- **Empathize**
- **Define**
- **Ideate**
- **Prototype**
- **Test**

1. Define
After gathering all the information from the empathize phase, the design thinker starts to analyze the observations and elaborate them to define the core problems which need to face for the following stages in the whole team.

In this phase, the designer should state the problem in a more objective way instead of a personal wish or need for a company. It also helps designers identify which features and functions or other elements should be taken into consideration. These
decisions can bring all the team fluidly to the third phase. People could also use “How might we...” questions to pass the stage into the next one.

2. Ideate
From the Empathise stage, designers understand the users and their needs, and the Define stage, this information, and observation are analyzed and summarized by an accurate statement. With this solid background, the whole team can begin to create solutions “out of the box.” Try to find benchmarks in different fields and use various design tools like Brainstorm to free mind and bring as many ideas as possible. At the end of this phase, designers could pick some of the ideation techniques to screen the best idea either for solving the problem or the solution to avoid it.

3. Prototype
To evaluate the idea generated from the previous phase, designers need to create the prototype now. The prototype could be very rough and not aesthetically “beautiful” at all, it could be a scaled-down version of the final product, or could be some of the specific features. The prototype may be shared and tested between the same team, but also could be a limited number of people out of the group. Through the prototypes, designers can continuously refine the idea and make it approach to “the best” solution for the problem identified before.

4. Test
At this phase, designers begin to test the final product identified during the Prototype phase. So in this phase, we can understand how the real user could face the product, how their reaction and experience. According to the design thinking method, the five stages are the iterated process. So even now, in the last phase, the problem could be redefined after the final test. So depends on the project, the ideation and prototype can be rebuild until the whole team creates the best product under certain conditions.
To help designers and non-designers confronting the various private and public challenges, the UK Design Council created the Double Diamond framework for innovations. The two diamonds represent two main design processes of the structure. In essence, the first one of exploring the problem widely or as deep as possible (divergent thinking) and then pass on process focuses on practical action and solution (convergent thinking). Based on the design thinking methodology, it also divides the design process into different stages.

**Discover.**
The first stage intends to let people understand the user: who are they, what the problems they are facing. Instead of assuming, it needs real talk and time spent with the people.
• **Define.**
With the help of insights gathered from the previous stage, people can begin to define an accurate problem statement to solve later.

• **Develop.**
The second diamond encourages co-creating and co-designing from people with different backgrounds and disciplines to seek the best solution to confront the issues identified before.

• **Deliver.**
Delivery allows the people to test the solutions in various scales; it could be a focus on specific features or the whole part. It can help people to find the defect and keep improving to get the final solution.

These two design thinking methodologies I presented have a very similar structure. Five stages model from Hasso-Plattner Institute of Design at Stanford have evident divisions of the stages; instead, the Double Dimond more emphasize the way of thinking for different phases. So even it’s a single people project, I would like to apply these methodologies to guide the whole project.
1.3 Process Flow Chart

Fig. 1.3.1 Process flow chart from project
2. E-LEARNING THEORY AND PRACTICE

2.1 Learning Theory

We should define “learning” itself the first before we talk about the role of artificial intelligence as educational technology in lifelong learning education.

What is “learning”? How do people “learn” something? And what is knowledge? These are questions concerning epistemology: “the study or a theory of the nature and grounds of knowledge, especially with reference to its limits and validity” (defined by Merriam–Webster dictionary). So the theory which explains how we come to know and how we learn the knowledge is called learning theory.

Learning theories can provide a clear guideline for an instructional designer. Knowing why you do and what you do in instructional design can construct your plans for education and enables you to feel confident for each choice in the project. At the same time, this confidence also could transfer from instructors/designers to the learners, providing a secure tier with a sense of security in both creating the instruction, and being able to learn.

There are three main categories which dominate learning theory: Behaviorism, Cognitivism, and Constructivism. These three theories also apply for an e-learning design project.

**Behaviorism:**

Behaviorism was the theory developed in the early 20 century based on series animal learning experiments. To teach a dog the instruction “sit,” when every time the dog does the correct action, the trainer will give a snack as a reward. Many psychologists used a similar mechanic to develop early learning theory. Behaviorists believed the learning is the sense of responding to the specific stimulus. And this series of activities can be observed quantitively, and also at the same time, the process occurring in mind can be ignored. So for this school,
learning as behaviors that can be measured with indicators. ¹

The implication for the E-learning:

1. Explicit in the beginning, the outcome of the learning program.
2. Make a test to assess the outcome.
3. Provide appropriately sequenced learning material.
4. Provide effective feedback

Cognitivism:

Cognitive science was developed significantly in the 1960s and 1970s. It also affected the development of learning theory. While retaining the framework behaviorism, cognitive science theories see learning as an internal brain process that involves memory and information processing. And according to this theory, the learner uses different types of memory during learning. Before the information processing starts, the brain receives information as sensation into the sensory store. The data needs to be transferred to working memory for less than one second; otherwise, it will be lost. But at the same time, if working memory is not processed efficiently, the information won’t be transferred into long-term memory for storage neither. The whole process depends on the learner’s amount of attention and also to the fact that whether cognitive structure is formed and well function.

And how to pass information could be illustrated in three ways.

Fig. 2.1.4 Different types of information map

The implication for the E-learning:

1. Make the strategy to structure and convey the information of the program. Make sure it’s easy to be perceived as sensation and be transferred into working and
long-term memory.
2. Make the strategy of retrieving the current information from long-term memory, and then to construct the new information.
3. The information should be screened and classified to prevent overload during the processing of memory. This action could facilitate better information and make the whole process more effective.
4. Make a variety of learning strategies for individual differences and learning styles.
5. Present the information in different modes to help the cognitive process.
6. Motivate the learners in different aspects.
7. Encourage learners to use their metacognitive skills during the learning process. For example, allow reflection and self-check or collaborate with other learners.
8. Use a variety of strategies to encourage learners to apply what they learned into different and real-life situations.

Constructivism

Constructivists see learning as proactive action rather than passive. It has a focus on the study of how learners interpret and extract their own meaning from the new information. And they apply and interact with this recent information into reality with other people and bring a fresh perspective. So constructivists see learning as contextual, and it should be adapted into a different situation, and learners can indeed apply the information broadly. Under this framework, constructivist educators become a role providing guidance "using a prior interpretation to construe a new or revised interpretation of the meaning of one’s experience in order to guide future action "³

Implication for the E-learning:

1. Make learning as an active process and involve meaningful actives that can apply to the individual real-world situations.
2. Learners construct their own meaning of new information instead of accepting the pre-definition from the instructor.
3. Encourage collaborative and cooperative learning to

facilitate a constructive process.

4. Learners should be given appropriate control and freedom at the same time. They could be allowed to decide for the learning goal under the instruction, but they also have enough time and opportunity to reflect if their process is in the right way.

5. Use different interaction (self-interaction, human-non-human interaction, instruction interaction) to help to monitor, to encourage, and to promote the learning process. 4
2.2 E-learning and Educational Technology

The Association for Educational Communications and Technology (AECT) defined educational technology as “the study and ethical practice of facilitating learning and improving performance by creating, using and managing appropriate technological processes and resources” ⁵. Educational technology refers to all the technological means and processes applied to education science. So in a given context it doesn’t need to imply a specific kind of physical technology. It’s the positive manner that promotes learning process to learners in variety learning environment, but at the same time it could be facilitated by educators or educational administrators. And its’ addition of ethical concept yields best educational practice strategies serving individual, organisations and society as a whole.

2.2.1 History

The use of media for instructional purposes is generally traced back to the first decade of the 20th century with the introduction of educational films (1900s) and Sidney Pressey’s mechanical teaching machines (1920s).

The concept of hypertext is traced to the description of memex by Vannevar Bush in 1945.

Cuisenaire rods were devised in the 1920s and saw widespread use from the late 1950s.

In the mid 1960s Stanford University psychology professors Patrick Suppes and Richard C. Atkinson experimented with using computers to teach arithmetic and spelling via Teletypes to elementary school students in the Palo Alto Unified School District in California.

In 1971, Ivan Illich published a hugely influential book called, Deschooling Society, in which he envisioned “learning

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web"s as a model for people to network the learning they needed.

The first online course was offered in 1986 by the Electronic University Network for DOS and Commodore 64 computers. Computer Assisted Learning eventually offered the first online courses with real interaction.

In 2002, MIT began providing online classes free of charge.

Videoconferencing has risen in popularity to reach over 20,000 students across the United States and Canada in 2008–2009.

**History of E-learning**

![Image of a timeline showing key events in the history of educational technology development, including the development of educational films, Sidney Pressey's mechanical teaching machines, Cuisenaire rods, Vannevar Bush's Hypertext, Stanford University's computer teaching of arithmetic and spelling, Electronic University Network's first online course, and MIT's free online classes.](image-url)
2.2.2 Type of Education Technology

1. Synchronous and Asynchronous

E-learning may either be synchronous or asynchronous. It can occur in or out of the classroom. Synchronous learning refers to a method that all participants interacting of the same period, while asynchronous learning is self-paced. Usually it offers different channels which allow participants exchange of ideas or information without involving the interactions of other participants at the same time. Synchronous learning allows the participants of learning activities exchanging of ideas and information real-time. Examples are live talking, face-to-face discussion, online real-time live teacher instruction and feedback. The tools could be Skype and chat rooms or other virtual classrooms where everyone is online and working together at the same time. Since traditional idea of learning activities the students are working collaboratively, synchronized e-learning system help students and teachers simulating the scenario of classroom. It continuously brings forward the learning activities actively and always be easy to give quick respond and peers. And usually synchronized learning make motivate students in more effective way.

Asynchronous learning may use technologies such as learning management systems, email, blogs, wikis, and discussion boards, as well as web-supported textbooks, hypertext documents, audio, video courses, and social networking using web 2.0. Asynchronous learning is beneficial for students who need a more flexible time frame. In the context of this thesis, for the adults who have a fix career life, asynchronous learning is easier to adapt to their real life. In asynchronous online courses, students proceed in their own arrangement. If they need to listen to a lecture a second time, speed up some part, or they need to think about some questions for a while, they may do so without concerning that they will hold back the rest of the participant of the same course. Through online courses, students can acquire a specific skill or knowledge more quickly, they can repeat failed courses without the embarrassment, or they don’t need to fear the barrier brought from different age, culture or society.
background. Learners have access to an incredible variety of enrichment courses in online learning, and can participate in college courses, internships, sports, or work and still get useful knowledge or even diploma at the same time.

2. Linear Learning

The linear learning refers to a frame based on computer-based training (CBT). It's usually self-paced learning activities delivered on a computer or handheld device such as a tablet or smartphone. CBT typically presents content linearly, much like reading an online book or manual. For this reason, CBT is often used to teach static processes, such as learning an operation of a process or completing mathematical equations. Similar as computer-based training, web-based training (WBT) is delivered via Internet using a web browser linearly.

CBTs provide learning stimulus beyond traditional learning methodology from textbook, manual, or classroom-based instruction. CBTs can be a good alternative to printed learning materials since rich multimedia, including videos or animations, can be embedded to enhance the learning. And assessing learning in a CBT is also easily scored by a computer as multiple choice questions, drag-and-drop, radio button, simulation or other interactive means. All the feedback and completion status can be easily scored and recorded.

3 Collaborative Learning

Computer-supported collaborative learning (CSCL) was designed to encourage or require students to work together on learning tasks with instructional method. CSCL is similar in concept to the terminology, “e-learning 2.0” and “networked collaborative learning” (NCL).

With technological Web 2.0 advances, sharing information between multiple people in a network has become much easier. One of the main reasons for its usage increasing states that it is an creative and engaging educational facilitator.

Collaborative learning offers participants mutual engagement channel in a coordinated effort to solve the problem together. It breaks the geographical barrier between the different school and it enhance educational outcomes and cultural integration.
2.2.3 Educational Media

Educational media and tools can be used for:

- Alternative forms of knowledge representation to give more engagement experience.
- Task structuring support and help to manage the system.
- Access to knowledge bases.

Audio and video

Can be either synchronous like streaming or asynchronous like webcasts or podcasts.

Computers, tablets and mobile devices

Very comment tools for collaborative learning, App become very important approach to learn.

Social networks

Group webpages, blogs, wikis, and Twitter offer learners and educators an engaging and easy way to communicate thoughts, ideas, and comments for a specific topic and field.

Webcam

Enable to create virtual classroom. It could also become a monitoring tool to avoid dishonesty.

Whiteboard

Digital whiteboard allows learners and educators can directly interact with writing and drawing easily.

Virtual classroom

Web conferencing software and augmented reality technology provides opportunity to simulate an engaging class room in digital world. It’s more direct, interactive and sociable compare to other means.

Learning management system

A learning management system (LMS) is software used for
delivering, tracking and managing training and education. It includes Learning content management system, computer-aided assessment, Electronic performance support system.

Training management system
A training management system or training resource management system is a software designed to optimize instructor-led training management.

Learning objects
The collection of content items, practice items and assessment items that serve for pedagogy issue.
2.3 MOOC in E-learning

MOOC is short for massive open online course is online course usually involving students, academic professors, teaching assistant, fields expert, universities and related companies. Compare to traditional online course it provides interactive elements and community, which allows unlimited participants and open access via web.

Early MOOCs emphasize open-access features such as free licensing of content, process, goals to promote the concept [7].

Although MOOC has limitation fully replacing the university, but it still the most effective educational technology for high education. Because of the initial point, MOOC provides affordable alternative access to formal and professional eduction. And compare to other educational setting, its online collaborative community and flexible learning schedule allow many people to use MOOC and let it become life-long education mode, especially to whom would like expand their career and education life even they are not student anymore.

Fig. 2.3.1 MOOCs and Open Education Timeline Li Yuan and Stephen Powell http://blogs.cetis.org.uk/cetis/2015/05/11/moocs-and-open-education-timeline-updated/

7 Udacity Hedges On Open Licensing For MOOCs
https://www.informationweek.com/software/udacity-hedges-on-open-licensing-for-moocs/id/1111226
The real development of MOOC started from the 2000s, with increasing online presence, open learning opportunities. Even at early time there were primary form for MOOC system, until 2012 MOOC became new mature approach for high education technology with the foundations of Udacity, Coursera and MIT edX. Alongside the development of these open courses, other E-learning platforms emerged — such as Khan Academy, Peer-to-Peer University (P2PU), Udemy, and ALISON — which are viewed as similar to MOOCs and work outside the university system or emphasize individual self-paced lessons.

The platform seems have emerged by multiple conceptions of MOOCs with development of time. There are two different types mostly: those that emphasize the learning theory of connectivism, and those that be similar to more traditional courses. To distinguish these two types, in the field people use the terms “cMOOC” and “xMOOC”.

**cMOOCs**

cMOOCs are based on the learning theory of Connectivism which emphasizes the power of aggregated knowledge. And all the material are remixable and re-purposable. It could be feed-forward through networking of different individuals, gathering diverse opinions but focusing on end-goals.8 9

According to George Siemens, co-creator of that first MOOC, cMOOCs are “based on the idea that learning happens within a network, where learners use digital platforms such as blogs, wikis, social media platforms to make connections with content, learning communities and other learners to create and construct knowledge.”

cMOOC allows to connect learners to each other and make them become dual role: learner and teacher at the same time. The participants answer questions for each other or they collaborate on joint projects to reach the same goal. So for the cMOOC platform, it usually demands collaborative development.10

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9  Kop, Rita “The challenges to connectivist learning on open online networks: Learning experiences during a massive open online course”, International Review of Research in Open and Distance Learning, Volume 12, Number 3, 2011, accessed 22 November 2011

10  George Siemens on Massive Open Online Courses (MOOCs) on YouTube
xMOOCs

xMOOCs have a much more traditional course structure. They are oriented for specified aim of obtaining certain knowledge certification. Usually they are a combination of pre-recorded video lecture with quizzes, tests, or other assessments. xMOOCs are centered around a professor rather than around a community of learners. However, some providers of xMOOCs require paid subscriptions for acquiring graded materials and certificates. And they make partnerships to institutions for content distribution. The instructor is the expert for specific field who provide or create knowledge, thus student usually have very limited chance to ask for assistance and to advise each other on difficult points during learning.
2.4 Case Study

This section I would like to introduce some existing products representative on the market which show the various directions of implementation of educational technology.

Unimersiv

Virtual class: immersive and engaging mode of learning

Unimersiv is the largest platform for VR educational experiences. Most companies do not create libraries of VR content, Unimersiv provides a unique curation of educational VR experiences where participants are given a detailed tour through to learn about different topics. Eventually, Unimersiv hopes that other VR experience developers will share their experiences on the Unimersiv library in addition to other app stores and platforms.

At present, Unimersiv has seven educational VR experiences available for download on its website including a journey to the human brain, exploring the International Space Station, human anatomy, Stonehenge, the Titanic, the Acropolis of Athens as it was thousands of years ago, and ancient Rome.

Fig. 2.4.1 VR course from unimersive
Edmodo

LMS: using facebook-like interface, the learning management system facilitates the learning process between the teacher and students.

Edmodo is a cloud-based LMS that allows for collaborative learning through content sharing, communication tools, and classroom management. Using Edmodo, students and teachers can reach out to one another and connect by sharing ideas, problems, and helpful tips.

It offers unlimited storage for content, which means administrators spend less time dealing with paperwork. Edmodo gives instructors and training managers one place to store, assign, schedule, and track, enabling them to efficiently run their digital classrooms. One of the pros of Edmodo is that it’s conducive to collaborative work: It allows everyone to share files with one other, a feature lacking in many learning management systems. This is a huge boon, since social learning has a high success rate.

Edmodo also has a unique user interface that reviewers compare to Facebook or similar social media platforms. According to the reviews, Edmodo has a conveniently short learning curve, and the social learning options are (pleasantly) reminiscent of a social media network. Connecting with other users is simple, which encourages a high degree of student to student interaction.
SoloLearn

Interaction course+ Social network for coding: The dynamic and gamification way to enhance the learning experience, and collaborative learning offers diverse approach for studying.

SoloLearn is an online and mobile learning platform that offers free coding classes in 13 different programming disciplines. The learning content is jointly created by SoloLearn and, increasingly, community contributors.

SoloLearn lets you learn and practice a skill of your choice anytime anywhere for free. It consists of very short videos (so the user does not get bored and keeps attention) and interactive checkpoints and practice sessions. The practice is real, i.e. programming students write real-life code and future photographers adjust camera settings in the app.

While learning, SoloLearners unlocks levels, build profile, unlock achievements, create and participate in forums, and get feedback from SoloLearn experts and other members of the community. The learners are people throughout the world that want to learn a new skill quickly and effectively to enrich their career and life choices.
Coursera is an online education company that serves over 20 million registered learners by partnering with 140 of the world’s best universities and education institutions. The company was founded in 2012, and it’s one of most representative MOOC platform around the world. On Coursera, anyone, anywhere can access over 1,000 online courses and Specializations in dozens of fields in order to achieve meaningful career, educational, and personal enrichment goals throughout their lives. Coursera can now be accessed with mobile apps for the Android and iOS platforms. Students can choose from classes in many disciplines.

Compare to other MOOC platforms, Coursera have several advantages. Some courses provide college credits because of collaboration with top universities. There are large number of subjects of course to choose from, and many of them are free. But there’re several limits on platform also: peer grading model is not always effective due to limited access to professors and recourse. And best courses on platform require a fee.
Transform the teaching instrument into digital: Use the mobile device as the media for learning instead of analog traditional teaching instrument.

Desmos is an advanced graphing calculator implemented as a web application and a mobile application. In addition to graphing both equations and inequalities, it also features lists, plots, regressions, interactive variables, graph restriction, simultaneous graphing, piecewise function graphing, polar function graphing, two types of graphing grids — among other computational features commonly found in a programmable calculator. It can also be used in several different languages.

Users can create accounts and save the graphs and plots that they have created to them. A permalink can then be generated which allow users to share their graphs and elect to be considered for staff picks. The tool comes pre-programmed with 35 different example graphs for the purpose of teaching new users about the tool and the mathematics involved. Moreover, activity modules for classrooms can be created through a teacher account.

**Challenge Slide #1**

<table>
<thead>
<tr>
<th>Equation</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>$y = -x + 25{14 &gt; x &gt; 10}$</td>
<td>In the rows below, type as many equations of lines as you need to collect all the stars.</td>
</tr>
<tr>
<td>$y = x + 5{x &lt; 10}$</td>
<td></td>
</tr>
<tr>
<td>$y = \frac{1}{3}x + 1$</td>
<td></td>
</tr>
</tbody>
</table>
Facilitate technology as new tool in educational context: Use technology in smart phone as part of experimental equipment for laboratory, sustainable, easy-accessible and funny for science lab course.

Lab4Physics is an educational solution designed to support teachers around the world improve science education, by making it easy and inexpensive to bring lab experiences into the classroom.

The Lab4Physics app leverages built-in sensors found in smartphones and tablets to transform mobile devices into a powerful science lab with multiple instruments that can be used flexibly by teachers and students. In this lab, students can find tools (like an accelerometer, a sonometer or a speedometer) that can help them measure gravity or acceleration in real time.

These tools can used in unlimited ways, allowing students to investigate, measure and analyze inside and outside the classroom.
Learning as game: Enhance the learning experience in funny and easy way, use gamification theory to promote learning process.

Duolingo is the most popular way to learn a language online, with over 300 million users worldwide. The founder Luis von Ahn successfully merged gamification and learning addicting people to languages and producing an app with over 300 million users. The app has become a staple example of mobile language learning. Duolingo’s mission is to make language education free and accessible to all. Duolingo is available on the Web, Android, and iOS.

Duolingo CEO knows that learning a language is a social process. That is why they’ve launched Duolingo Language Club in the beginning of 2017. That is an optional social component to the language learning experience. There are several research papers that prove that the app is helpful in studying languages. It is a scientific fact - one is able to learn a language with Duolingo.

In the iOS version of app, the learners can “communicate” with bots. Chatbots can maintain a conversation to practice the speaking skills. It seems like a great way to improve the ability to chat with real people by practicing on the machines.
2.5 Conclusion

The instructional applications design should be based on learning theory frames, now behaviourism, cognitivism, and constructivism are still three most applicable ones. Then in the context of educational technology, online-learning systems usually use different media, type of e-learning and MOOC system for high education to promote the process of study. And in the final part the article chose some most representative learning product in sense of educational technology to depict general overview about the possibility and direction for the future design.
3. ARTIFICIAL INTELLIGENCE IN EDUCATION

3.1 AI that works for people

3.1.1 What is artificial intelligence

When we talk about artificial intelligence (AI), we tend to think of smart robots doing advanced things on their own. Like in the film I, robot, Sonny even broke the rule human created and made his own choice. Perhaps people also think AI in dangerous ways, now or in the future. We do not want to consider of Google translation, Amazon book recommendations or Netflix movie suggestions, scan-to-text software, digital personal assistants (managing to-do lists, online orders, and reminders, finding info online, etc), and other such applications of AI that are fast becoming part of our everyday lives.

Artificial intelligence (AI) is an area of computer science that emphasizes the creation of intelligent machines that work and react like humans. So why people react like this? Because most of people when they think about the AI, effected by so many sci-fi movie, they think of intelligent machine that could successfully perform any intellectual task that a human being can. So it should be an “robot” that’s capable of feeling and expressing the consciousness. But in the real world, this kind of AI is only one kind, which is called “artificial general intelligence” or “strong AI”. AGI must embody the following essential abilities:

• To autonomously and interactively acquire new knowledge and skills, in real time. This includes one-shot learning—i.e. learning something new from a single example.
• To truly understand language, have meaningful conversation, and be able to reason contextually, logically and abstractly. Moreover, it must be able to explain its conclusions!
• To remember recent events and interactions (short-term memory), and to understand the context and purpose of actions, including those of other actors (theory of mind).
• To proactively use existing knowledge and skills to accelerate learning (transfer learning).
• To generalize existing knowledge by forming
abstractions and ontologies (knowledge hierarchies).

- To dynamically manage multiple, potentially conflicting goals and priorities, and to select the appropriate input stimuli and to focus on relevant tasks (focus and selection).
- To recognize and appropriately respond to human emotions (have EQ, emotional intelligence), as well as to take its own cognitive states—such as surprise, uncertainty or confusion—into account (introspection).
- Crucially, to be able to do all of the above with limited knowledge, computational power, and time. For example, when confronted with a new situation in the real world, one cannot afford to wait to re-train a massive neural network over several days on a specialized supercomputer.\textsuperscript{12}

\textsuperscript{12} From Narrow to General AI Peter Voss
https://medium.com/intuitionmachine/from-narrow-to-general-ai-e21b568156b9

\begin{figure}[h]
\centering
\includegraphics[width=\textwidth]{fig3.1.1.1_summary_for_artificial_general_intelligence.png}
\caption{Summary for Artificial general intelligence}
\end{figure}

\begin{figure}[h]
\centering
\includegraphics[width=\textwidth]{fig3.1.1.2_summary_for_narrow_artificial_intelligence.png}
\caption{Summary for Narrow Artificial intelligence}
\end{figure}
The technology application is still very limited in this area, and it’s still impossible to realize a robot like Sonny in I, Robot or even C-3PO from Star Wars. So now we’ll need more than the contemporary approaches to achieve anything resembling human intelligence—current applications are extremely narrow in scope, and cannot use their current knowledge and skills to acquire skills in new domains. Also, they typically cannot learn directly from user interaction, have no memory and will make the same mistakes over and over again. Furthermore, they cannot reason or explain themselves, have very limited understanding and no common sense. The researchers are intending to break the limits through development of different algorithms and the approaches perhaps a “Third Wave of AI.”

So as we see, most of the application of artificial intelligence now is not that “smart”, and it only can solve the problem in the specific context. Like you use Amazon recommendation system to choose what things to buy next, but you never use it to decide which girl or guy you want to go out with. We call this kind of artificial intelligence technology “weak AI” (or narrow AI). It’s artificial intelligence that is focused on one only task. Even like this, with help of AI technology, more and more product become smarter: they became our agency instead of a still product. Like a calendar is not only a product to make sign for appointment and place schedule, it also give us reminders about when to do what, and which is best route. Then artificial intelligence already became one of the most efficient technology for agentive product.
3.1.2 Three factors bring AI to life

Think about the history of artificial intelligence, it was founded in 1956, so till now it has existed for over 60 years. So why now? Why it’s suddenly become new technology trend of so many digital products? Why people keep talking about it? Indeed, the convergence of three forces sparked the AI revolution and made it possible to use AI techniques to build real-life applications.

1. Computing power

If we jump back into 90s, think how to surf on internet: dial the number, wait for load a page and use the web in a very limited way. And sometimes even a simple programme for today can make your computer “screaming” in that time. Of course we are not talking about personal computer here, but computing technology truly affects the application of AI.

To build high-functioning systems, hardware and infrastructure are necessary. Computer industry is always try to shrink the size and price of the components and devices while increasing in computing power, which is key to AI’s progress now. It has only been in the past few decades that computer processing power has evolved to support AI systems. Faster computers can process more data and perform higher caliber functions as a result.

This is playing a critical role in future AI advancement. In the tech world, companies are racing to develop a computing model that meets the accelerated pace of AI software development. Google has rolled out TPU (Tensor Processing Units) which it claims to be 15 times faster than a GPU (graphics processing units) and designed specifically for machine learning.

IBM is working to develop a quantum computing system to power their supercomputer Watson. There’s also cloud storage and computer power to consider. Tapping into the cloud is allowing these smart devices and apps to communicate and learn from one another while storing vast amounts of data.

2. Big data
We are generating more data today than ever before. Amazon records every single behaviour and transaction within online shopping experience. Google searching engine collects each data we input in the box. A single modern car has 100 or more sensors that monitor functions such as fuel level and tire pressure. Every day, we create a massive amount of data, and that number is expected to increase exponentially over the coming decade.

So what is big data? Big data are extremely large data sets that may be analysed computationally to reveal patterns, trends, and associations, especially relating to human behaviour and interactions. Like consequence effect with new applications and processes being created every day, we’ll have an increasing number of sensors, systems, and devices to transmit even more data. Much of these big data they collect are unstructured form, the they need to be organized and analyzed. Often, data scientist is required to clean and prepare unstructured datasets for machine learning.

IBM is pioneer of this realm, years ago (2013) IBM reported 90% of the data in the world today had been created in the last two years alone. In Data Age 2025, market-intelligence firm International Data Corporation (IDC) forecasts that by 2025, global data will grow to 163 zettabytes (or a trillion gigabytes). That’s 10 times the 16.1 zettabytes of data generated in 2016.

3. Better algorithm

This explosion of data as base has supported scientists to refine and discover new algorithms and extensions for machine learning which is one of the core of AI technology now. Before basic algorithms just told computers what to do step-by-step. Now, algorithms have become smarter that they facilitate machine learning and allow computers to learn on their own. Using datasets as past experiences to train, machines learn with instruction by algorithm on what they should do next.

For example, autonomous vehicles rely on enriched visual data to navigate the real world. That is, each frame of video collected by autonomous systems must be enriched with data that identifies objects, such as a road sign, pedestrian, etc., in
3.1.3 Machine learning and deep learning

Think about the history of artificial intelligence, it was founded in 1956, so till now it has existed for over 60 years. So why now? Why it’s suddenly become new technology trend of so many digital products? Why people keep talking about it? Indeed, the convergence of three forces sparked the AI revolution and made it possible to use AI techniques to build real-life applications.

People are used the term “AI” and “machine learning” interchangeably, especially in the realm of big data. But they aren’t the same thing, and it is important to understand how they can be applied differently.

In a simple word, machine learning is simply a way of achieving AI.

Artificial intelligence is a broader concept than machine learning which you can see from the figure below, which addresses the use of computers to mimic the cognitive functions of humans. When machines carry out tasks based on algorithms in an “intelligent” manner, that is AI. Machine learning is a subset of AI and focuses on the ability of machines to receive a set of data and learn for themselves. Instead of mimicking human behavior (AI) but mimicking how humans learn. In a word, Machine learning is a way of “training” an algorithm so that it can learn how. And it can be expressed in a three aspects:

Understanding:

- Classification (spam, churn, fraud, image classification)
- Regression (Forecasting pricing)
- Personalization (Recommender systems)

Reasoning:

- Robotics
- Games
• (Some) Optimization

Generating:

• Translating (language, speech to text, text to speech)
• Art

Fig. 3.1.3.1 The relationship between AI ML and DL

Training computers to think like humans is achieved partly through the use of neural networks. Neural networks are a series of algorithms modelled after the human brain. Just as the brain can recognize patterns and help us categorize and classify information, neural networks do the same for computers. The brain is constantly trying to make sense of the information it is processing, and to do this, it labels and assigns items to categories. When we encounter something new, we try to compare it to a known item to help us understand and make sense of it. Neural networks do the same for computers.

An artificial neural network is an interconnected group of nodes, akin to the vast network of neurons in a brain. Here, each circular node represents an artificial neuron and an arrow represents a connection from the output of one artificial neuron to the input of another (see Fig 3.1.3.2).
Benefits of neural networks:

- Extract meaning from complicated data
- Detect trends and identify patterns too complex for humans to notice
  - Learn by example
  - Speed advantages

Deep learning goes into another level deeper and can be considered as one of many approach of machine learning. The concept of deep learning is sometimes just referred to as “deep neural networks,” referring to the many layers involved. In order to deal with more complicated problem, deep neural network has two or more layers compare to neural networks which usually only have a single one. The layers can be seen as a nested hierarchy of related concepts or decision trees. The answer to one question leads to a set of deeper related questions.

Deep learning networks need to see large quantities of items in order to be trained. Instead of being programmed with the edges that define items, the systems learn from exposure to millions of data points. An early example of this is the Google Brain learning to recognize cats after being shown over ten
million images. Deep learning networks do not need to be programmed with the criteria that define items; they are able to identify edges through being exposed to large amounts of data.¹⁵
3.2 Agentive framework

3.2.1 Agentive technology

According to Christopher Noessel artificial intelligence now serves as agentive technology in most context. So what is agentive technology?

“In the simplest definition, an agent is a piece of narrow artificial intelligence that acts on behalf of its user.”

Agentive technology watches a data stream collected by users for triggers and then responds with narrow artificial intelligence. And it helps its user to accomplish some goal and make decisions. So “acting on your behalf” : It that it does its thing while out of sight and out of mind for us, something we could find it’s very tedious but useful, like one action in particular moment, or a special kind of activity on the internet, or security events on a computer network. In a phrase, it’s a persistent, background assistant. So it is foundational to the notion of what an agent is, why it’s new, and why it’s valuable.

An agent can be said to be more intelligent when it has the following characteristics:

• **Its model of its domain is more reticulated and closer** to our own.

• **It successfully monitors more**—and more complex—data streams.

• **It can make smart inferences.** It can smartly infer what given data means and react accordingly.

• **It can plan.** This means considering multiple options for achieving a goal, taking into account the trade-offs between them, and selecting the best one.

• **It is adaptable.** It’s able to use feedback to track its progress toward its goal and adjust its plans accordingly.
• In advanced agents, this can mean the capability to refine predictive models with increasing experience and as new real-time information comes in.

It’s not assistive technology, even it seems subtle. For example if you want to buy an international airline ticket to a favourite destination. Assistive technology would list all your options and the trade-offs between them apparent, helping you avoid spending too much money or being exhausted on transfer planes. You make your own selection. While an agent would vigilantly watch all airline offers for the right ticket and it also records all your preference, it would pop out the proper choice specific for you directly. If it was very confident and you had authorized it, it might even be capable to make the purchase for you. Thus an assistant should assist you with a task and an agent takes agency and does things for you.

As this concept, the conversational “agents” are not agentive technology we talk about here, they are more as assistant. Same as robot, the software for which is tightly coupled to the hardware. An agent may embody a robot, and a robot may operate as an agent. And for automation, where has as its goal the removal of the human from the system, while agentive technology is explicitly in service to a human.

3.2.2 The frame of agentive technology

For most computer-related system people use specific frame diagram to express the process of how they work. Lisanne Bainbridge calls it in a academic way “Monitor -> Diagnose -> Operate”. From computer’s perspective, it could be called as “Input -> Processing -> Output.” To really explain this process in a more human-like way, Christopher Noessel use “See -> Think -> Do.” just like in diagram it depicted as a loop (see Fig. 3.2.2.1)

The loop can describe interactions at many levels. It could describe normal task process but also could be for some microinteractions. Here “see” refers to “sense”, the way of “perceive” of a certain thing. She sees that the fridge is empty -> she thinks that she could buy something to refill the fridge -> She goes online supermarket. This is very simple scenario but more commonly commonly, scenarios are made of many see-
think-do loops in succession (See Fig. 3.2.2.1).

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The loop describes a person using a certain thing, and that thing has its own mechanism as it responds to what the person does. The one which responds, in this context, usually is most a computer system. In previously we mentioned before a loop of input -> processing. The loop (Fig. 3.2.2.2) describes a person using a certain thing, and that thing has its own mechanism as it responds to what the person does. The one which responds, in this context, usually is most a computer system. In previously we mentioned before a loop of input -> processing -> output. In the following “bow tie” diagram, the human’s loop as red, and the blue loop which represents the computer’s action respond
the human’s loop. The diagram also describes the back-and-forth of interactive systems.

output. In the following “bow tie” diagram, the human’s loop as red, and the blue loop which represents the computer’s action respond the human’s loop. The diagram also describes the back-and forth of interactive systems.

We use this structure as base to check how things change with assistive technologies. In system narrow AI helps a person to perform some task. The computer might be helping visualise or highlight the information (see), doing calculating or offer different option according to some conditions (thinking) acting as an interpreter to complex APIs (doing). So there’s an additional curve line along the human’s loop in the diagram assistive technology system (Fig. 3.2.2.3). It covers seeing, thinking and doing while human does heavy-lifting.
When we shift from an assistive to an agentive perspective, the graph changes to show the computer system doing the heavy lifting, with human only interacting occasionally. The agent takes the most actions of the task, but only share it with the user when the task is complete or when asked. While using a tool might have to define the start and stop, agentive service ask for more on setup and disengagement. The following graph illustrates this structure for understanding and applying the scenarios that are new to agentive systems (Fig. 3.2.24).

3.2.3 New Technologies to consider

To realise the agentive technology service system we mentioned above, there could several AI technologies involve in the process. From the purpose for an agent and how it has been realized, they can be easily understood by the frame mentioned by Christopher Noessel “See -> Think -> Do”. And at the
same time we can also begin to think how these technologies could apply into future system design. And all the following technologies are based on the existing APIs, IBM Watson service and Microsoft’s Cognitive Services.

**Seeing**

To achieve the function of agent, the system needs be able to sense everything nessacery to perform its job. Even some of them for human users are unnotable, because they are the very natural part of human being, but they have to be mentioned separately to highlight. And with them the system is equipped with capacities of sense.

- **Object recognition**: Enables a computer to identify objects present in an image or video feed.

- **Face recognition**: Helps a computer identify a person with computer recognition of their facial features.

- **Biometrics**: Helps identify a person through physical metrics. There are dozens of biometric technologies including fingerprints, voice prints, and even the unique pattern of capillaries in the eyes or just beneath the surface of the face. Biometrics can assist other higher-order algorithms, such as heart rate, helping convey stress in affective computing.

- **Gaze monitoring**: Helps the computer determine where the people around it are looking, and inferring intention, context, and even pragmatic meaning from it.

- **Natural language processing**: Allows the user to give instructions or ask questions of a computer in everyday language. The algorithm can also identify keywords, unique phrases, and high-level concepts in a given text.

- **Voice recognition**: Computer parses the messy sounds of human speech into language.

- **Handwriting recognition**: User inputs data and instructions through handwritten text.
• Sentiment: Computer determines the pragmatic sense of a text; whether it is positive or negative, or even whether the speaker is being ironic.

• Gesture recognition: Computer interprets the meanings conveyed through body positions and motions.

• Activity recognition: Computer infers what activities a person is engaging in, and it changes modes to accommodate the different activities. A simple example is helping computers understand that people need to sleep, and recognizing when this is happening and know that its behavior should change during this time.

• Affect recognition: Computer infers a user’s emotional state from a variety of inputs such as the tone of their voice, their gestures, or their facial expressions.

• Personality insights: Simply moving through a connected world and participating in social media, we tell a lot about ourselves and our opinions, interests, and problems. If a user gives an agent permission to access these digital trails, much of the user’s goals, personality and frustrations can be inferred, saving them the trouble of having to tell the agent explicitly.

Thinking

There are many powerful artificial intelligence engines allowing the system to emulate the process of human brain. Although it’s good to collaborate with developer to do a proper agentive system, understanding the basic engines and algorithm is something necessary for designing the project.

• Domain expertise: Grants an agent an ontological model of the domain in which it acts. This can be as simple as awareness of the calendar or a fixed pattern for sweeping a floor, or as complex as thermodynamics.

• Common-sense engines: Encode a body of knowledge that most people would regard as readily apparent about the world, such as that “a rose is a plant” and that “all plants
need water to live.” Although people consider such things unremarkable, computers must be taught them explicitly.

- Reasoners/inference engines: Make use of common-sense engines, the semantic web, and natural language parsing to make inferences about the world such as “a rose needs water to live” from the givens above.

- Predictive algorithms: Allow a computer to predict within a range of confidence variable outcomes based on a set of givens, and act according to its confidence in a particular outcome happening.

- Machine learning: Enables a computer to identify patterns in data, as well as improve its performance of a task to be more effective toward a goal.

- Trade-off analytics: Can make a recommendation for users balancing multiple objectives, even with many factors.

- Prediction: By comparing individual cases against past examples, algorithms can predict what will likely happen next. This can be as small as the next letters in an incomplete word, next words in +

**Doing**

All the agentive activity has purpose. But for the digital world how an A.I. agentive system reach the goal from user and present them in a tangible way? Here there are some most comment media which allow the system “do”:

- Screens: Present graphic information.

- Messages: Convey textual information.

- Sound: Convey information audibly.

- Speech synthesis: Lets agents generate human-sounding speech for conversational output.

- Haptic actuators: Let agents generate touch
sensations. For example the vibrator in smartphone is one example, or the rumble pack in video game console controllers.

- Robotics: Let agents control a physical device precisely. It could be simple as a robot vacuum cleaner or could be also as complicated as car-manufacturing robot arms on a factory floor, or human-emulated robot as NAO or Sophia with emotions and expressions.

- Drones: Let agents control a mobile robot, whether swimming, driving, flying, or propelling through space.

- APIs: Allow computers to interact with other computer systems and other agents, passing information, requests, or responses back and forth, including across the world via the internet, and across the room through short-distance wireless.

A typical AI agentive system process as below:

- Setting Up the Agent
  - Understanding the agent’s capabilities and limitations.
  - Conveying your goals and preferences.
  - Granting your permissions and authorization.
  - Taking the agent out for a test drive.
  - Launching the agent.
  - Discovering and adding new capabilities as they come available or grow popular.

- Seeing What the Agent is Doing
  - Monitoring what's happening.
  - Receiving notifications of successes and problems.

- Having or Helping the Agent Do Stuff
  - Pausing and restarting the agent.
  - Playing alongside the agent.
  - Tuning triggers and behaviors such that they perform better in the future.
  - Handing off the task to some intermediate person, or even a different, non-human actor.
  - Practicing the main task to maintain skills.
  - Taking over the task from the agent.
  - Handing the task back to the agent.

- Disengaging from the Agent
  - The user’s no longer needing the agent.
  - The user’s passing.
3.3 Natural Language Processing

Natural Language Processing (NLP) is an area of research explore the A.I. based application to understand and express natural language text or speech like a real human. So the researcher have to prepare the knowledge from two level: first is how human beings understand and use language and second is what techniques and appropriate algorithm can be developed to make computer systems understand and manipulate natural language. Then the application can accomplish task related to natural human language.\textsuperscript{17}

There are several significant applications for Natural Language Processing\textsuperscript{18}.

- **Information Retrieval** is the activity of obtaining the information need from a collection resource. So the system need search for information in a document easily including texts, images or sounds. Here we focus on NLP information, the computer can understand what we want to search more precisely. It can offer the best options among the millions of answers and interpret the real meaning behind few words and directly go to the point.

- **Information Extraction** focuses on the recognition tagging and extraction into a structured form. So it can help manage the information from different forms like news, articles, social media posts and so on. And give them a structured presentation and avoid the tedious manual work.

- **Question-Answering** - instead of offer the answer with a list of potentially relevant documents like Information Retrieval, Question-Answering provides the response directly with the text of answer itself or answer-providing passages.

- **Summarization** is the higher levels of NLP. It can allow an application to reduce a large paragraph of text into a very short one. And abbreviated narrative representation still keep the essence of original document.

- **Machine Translation** is the machine translation process from one language to another. It started with “word-
based” way but it cannot produce a good translation so recent year, machine translation includes more phrase analysis instead of translate word by word.

- **Dialogue System** is a computer system intend to converse with end user with a narrowly defined area. Like smart refrigerator know what you put inside and recommend you what to eat today. Dialogue systems have employed text, speech, graphics, haptics, gestures, and other modes for communication on both the input and output channel.

**Case from Automated Scoring**

There are several systems have already been implemented with the help of NLP technology.

Using natural language processing, Educational Testing Service (ETS 19) developed a series of applications to compute the score to reduce the cost and effort involved in using human graders and it’s called Automated Scoring (AS). (Fig. 3.3.1)

19 ETS, 2010, Using natural language processing (NLP) and psychometric methods to develop innovative scoring technologies, online report

Fig. 3.3.2 ETS Text Adaptor system
According to the report from ETS Automated Scoring and NLP Technologies, the organisation began to conducting research on automated scoring with NLP from 1990s. Now, the e-rater engine is used to assist human raters in scoring academic essays on the GRE® General Test and the TOEFL® test. After 10 years of evaluations from system, The e-rater engine can reliably suppose a score very close to human graders gave.

These years, ETS also developed more scoring applications to confront their needs: the c-rater TM system, the m-rater engine, and the SpeechRater SM engine. ETS also uses NLP to develop learning tools and test development applications, as well as the Text Adaptor tool. And as following I chose most relative one to present.

1. The c-rater system

The c-rater system is the automatic analytic-based content scoring system for short free-text responses. Its rang is from a few words length to approximately 100 words.

Analytic-based content is the kind of content that is predefined by a test developer to build the main ideas or concepts. These concepts give the evidence that, students needs to demonstrate as her/his knowledge in his/her response.
There are four main processes in the c-rater system (Fig. 3.3.3):

1) The first is building a model by Sample Responses (SR). In this step a set of model responses are generated manually or automatically.

2) Second, the c-rater system automatically processes model responses and students’ responses using a set of Natural Language Processing (NLP) tools and extracts the linguistic features.

3) Third, to recognise main points, a matching algorithm would be used to verify automatically wether a student’s response the same thing or at least implies the right concepts. In the process the linguistic features will be concluded from both SR and NLP.

4) And fourth, the c-rater system determines a score with certain score rule and then individualized instructional feedback that justifies the score to the student.

2. The e-rater engine

ETS first applicator the e-rater automated essay evaluation and scoring engine in 1999 to provide one of two scores for essays on the writing section of the Graduate Management Admissions Test® (GMAT®).

There are several features related to writing quality and decide the essay scores in the e-rater engine. They are: grammar, usage, mechanics, style, organization, and development. Using natural language processing computational methodology, the system identifies and extracts linguistic features from stored, electronic text or even speech. The engine’s score predictions have been shown in order to compare to human reader scores, and it can automatically highlight or detect off-topic responses as additional capabilities.

3. The Text Adaptor Tool

The Text Adaptor tool is a web-based technology which supports the process of instructional scaffolding. It facilitates student content learning especially focused on non-native English speaking learners. Currently, the the
Text Adaptor tools is part of a professional development package for teachers including:

1) Guide teacher for professional development and support to build linguistically targeted instruction and linguistic awareness.

2) Lessons, activities, material/text, and assessment authoring tools to support the application of the professional development.

The Text Adaptor tool could guide the teachers to use effective text modification strategies. While the system designing it was already taken into account the linguistic challenges English language learners may face when working with academic texts, and then put these points into instructions and support teachers’ ability to develop text-based curriculum materials. Once teachers are trained, they can use the Text Adaptor tool to support themselves any authoring and modification of text related to instruction or assessment in the classroom.
3.4 Adaptive Learning

According to a report from EDUCAUSE Learning Initiative community adaptive learning is a kind of technique using data-driven and nonlinear approach to instruction and remediation and providing personalised learning experience to user. Adaptive learning systems dynamically adjust to student interactions and performance level. They provide customised learning paths through deliver the types of content in an appropriate sequence at specific points corresponding individual learners’ needs and make progress. These systems exploit algorithms, assessments, student feedback, instructor adjustments/interventions, and various media and continuously do remediation for the students. And the process is a mutual action for both systems and users themselves.

There are three types of adaptive learning systems.

1) Closed system with existing and the course taken from existing stock or supplies, it allows for rapid implementation.
2) Open systems, they allows users to control all of the configuration and also content decisions.
3) Hybrid systems, they have limited configuration but it balances time consuming to develop the system and flexibility for control content and assessments.

To reflect the learning objectives for the course modules within the adaptive learning system set up the learning content, the concept sequencing, and the assessments. The systems will choose the content based on the performance of students themselves and the students of similar demographics or abilities, or they could use predetermined learning paths based on assessment data. As students progress through a course, they may see information displayed in various ways, tailored to their learning needs. So in a word to say, the systems “learn” from student interactions history and then they adjust the path and pace of learning. So for the open and hybrid system, faculty can adjust algorithms, content and assents to the needs of individual students.

In the real application situation adaptive learning system like Adaptive Educational Hypermedia Systems (AEHS) has
very complicated model. The AHAM model consists of two main layers, run-time layer and design layer. The run-time layer contains the adaptation engine that performs the actual adaptation. And the design layer stores information about the Media Space, the Domain Model, the User Model and the Adaptation Model. Figure 3.4.1 presents a generalized architecture of an AEHS, illustrating the main components of the AHAM model and their interconnections. The dashed lines in this figure represent a logical connection between the linked models. According to the above architecture the design process of an AEHS involves four key steps:

- Designing the Domain Model, is a concept of hierarchy for describing the subject domain ontology. It’s the process of designing a hierarchy of learning goals.

- Designing the User Model, that is, the process of designing the model for learner’s preferences and characteristics of cognitive. Thus it should also define the Knowledge Space.

- Designing the Media Space, that is, the process of designing the model which can describe the characteristics of the educational learning resources.

- Designing the Adaptation Model that is the process of defining the different rules for selection of concept, selection...
of content and the sequence rule which generates appropriate "learning paths". After finishing design of AEHS mentioned above, to generate personalised learning paths the adaptation engine, is responsible for interpreting the adaptation rules indicated in the Adaptation Model. This process is called in the literature adaptive educational hypermedia sequencing.

Adaptive learning technology also has been implemented successfully in online General Psychology course with Realizeit platform\textsuperscript{23} and various publishers and content providers—including Cengage, Khan Academy, McGraw-Hill, and Pearson—have developed adaptive learning tools also. Some new providers like Realizeit mentioned before and Smart Sparrow, Cerego, Acrobatiq allow system can be customized. Instead of adoption fro individual instructors, universities apply the technology into institution-wide implementations. E.g. at Northern Arizona University, adaptive learning supports 48% of freshmen students through individual pacing and teaching. So even the adapt learning technology still need to be developed, but it has started to appear in the market as important technology to support products and systems.

3.5 Conclusion

This chapter mainly explains how does artificial intelligence work and how to implement this technology inside the real world systems. In this chapter I introduced the framework of agentive technology by Christopher Noessel. Then it also describe in details some AI technology could apply in the educational system or directly related: Natural Language Processing and Adaptive Learning System. All of these technologies would become the base that how AI can become effective educational technology for the later design project.
4. PROJECT RESEARCH AND ANALYSIS

According to the design process, the first stage is to Empathize: to understand the people, to know what they feel and how they think for the specific issue. Then, with so many theories introduced before, I would like to know who is my target, how exactly people learn in their spare time, what they would like to gain, and what are their difficulties during the whole process. So in this phase, I try to open the question and make the problem divergent. So I used the survey as the starting point.

4.1 Survey and learning behavior

To understand people's needs and opportunities for the project, I used online-survey to collect the information. The survey is an excellent tool for designers to get a broad picture of the general target group.

While it is designed carefully, people can create an overview through the tool, how people use a product, do things, or have an experience. And at the same time, we can quickly get their opinions on it with an idea of which pieces are more important than others in this whole picture. By using a limited amount of open-ended questions, we can also get some more qualitative insights on the final problem.

So the survey was designed to collect the information from 3 main parts:

- Who are they?
- How do they learn?
- And their opinions of existing e-learning system

For details of understanding this process and behaviors, I divided the questions into the following items:

Motivation
Subject
Way of distribution of time

Environment
Learning plan
Type of course
Important factors

Difficulties and problem (general and online)

The survey was launched in different forums and social network platforms. So it wasn't limited by a specific range of age or geolocations.

For less than 20 days (Mar. 2018), I collected 135 answers from different countries.

Age:
21-25 yo: 36,3%
26-30 yo: 26,7%
31-35 yo: 11,9%
36-40: 10,4%

Gender:
Male : 37,8%
Female : 61,5%

Occupation:
Student : 48,9%
Company employee: 30,4%
Others are in the indifferent life status: such as unemployed, in the phase of a startup, or they didn’t specify the situation.

Geolocations:
The participants in the survey came from 26 different countries across Europe, Asian, North America, and Latin America.

Motivation:
For the motivations to learn something in their spare time, most people gave two main directions of the answer: The first one is related to personal life sustainability: There are 54,2% of participants chose the option “It’s only for supporting
my hobby, just for fun.” and 64.8% of the participants chose the item “it enriches my life and self-sustainability.”

The second highlighted motivation is about professional growth: There are 50.3% of people chose “It’s related to my current profession, and I think it would be useful in the future.”; And 53.4% person chose “I want to obtain new skill and knowledge which could bring opportunity for other kinds of career.”.

**Subject:**
From the answers, so many participants named the subjects which they want to learn are related to language and computer coding language. Some of them indicated the subjects related to their own profession. And the topics related to humanities and music are also prevalent.

**Way of distributing the time:**
40% of the total participants to choose to learn every day sometime. For the rest of the participants, around 25% chose “Once or twice in a week for some hours.” around 26% chose “I would like to utilize fragments of time.” For these two options, it appeared that Asian people prefer more to use fragments of time.

**Environment:**
Over 55% of the participants chose they prefer at home to learn. And around 30% of people expressed they don’t have preferences for ambiance.

**Learning plan:**
There are over 50% of the participants expressed they don’t have any plan for study. And around 30% chose the uncertain answer. And in these 135 people, only about 25% follow the program often, over 50% can guarantee to catch up their plan “sometimes.”

**Type of course**
Around 45% of the people chose “I always collect information and material by myself.” The people participate in the course off-line and online course have a very similar number of around 20% of total people.

**Important factor**
20 days

135 answer sheets

Gender:
- 61.5% Female
- 37.8% Male

Occupation:
- 30.4% Student
- 48.9% Employee

Age:
- 36.3% 21-25
- 26.7% 26-30
- 11.9% 31-35
- 10.4% 36-40

Geolocation:
- Over 26 countries
For this part, I would like to know in general, which are the critical factors that affect the learning process and could become an issue for adults and young adults. From the survey, I got one of the most disturbing points is “Missing strong motivation to push forward.” there were over 75% of people who chose this option, and other significant factors are “An engaging way of learning.” (45%) and “High quality of learning material.” (41%)

**Difficulties and problem (general and online)**

To understand the obstacles of their learning experience in their spare time, I directly ask the questions, and I got the answer. Over half of the participants expressed that they don’t have enough time for their personal learning. And hard to be focused on the study and easy to get distracted is one of the essential factors that impact their learning process. For the existing online learning platform, they indicated that one of the weak points is “lack of feedback and practice.” (38%) “lack of monitoring” “lack of interaction between teacher and students” “not engaging” are other reasons that make current online learning platform are not the perfect learning instrument for them.

**Conclusion and insight:**

If analysis their open questions individually, we can elaborate their pain points which are mostly from their life struggle:

//Personal needs and society needs  
//Life phase  
//Culture different

And as conclusions we understand:

Life-sustainability and professional growth related are two primary motivations, and actually, most of the people rely on both.

Most of the people would like to study every day a little bit.

Most of the people would like to learn at home; then also there
Motivation:

“"It enriches my life and self-sustainability!""

64.8%

53.4%

“I want to obtain new skill and knowledge which could bring opportunity for other kinds of career”

Subject:

Languages  Coding  Professional related  Humanities

Way of distributing the time::

40 %  Everyday sometime

25 %  Fragmental time

26 %  Once/twice a week
are people having no specific preference

A large group of people don’t have a clear learning plan and collect information by themselves.

Motivation and engaging way of learning are two of the most important things

Emotional and time are the main difficulties for the learner, then is the resource.

Missing feedback and practical opportunity to test result reference:

https://forms.gle/f4RsFUefz3rzjNvh8
https://wj.qq.com/s2/1914920/3632
Environment:

OVER 55%

HOME

Learning plan:

OVER 50%

NO STUDY PLAN

Type of course

OVER 45%

“I always collect information and material by myself.”

Factor and difficulty

“Missing strong motivation to push forward.”

75%
4.2 User research interview

As the first part of this thesis, the starting point of the project is to discuss how technology can impact and improve the life-long education process. Instead of the focus on children’s and adolescents’ educations, this study focuses on adults who already stepped into society. Or at least the young adults who are preparing all the conditions for entering the real world. Then for this project, I chose to focus the people from 20-55 years.

So not like a student who dedicates most of his/her time on learning, usually an adult should make the right balance between work and personal life. And for the part of personal life, depending on individuals, it could be combined by family, social, entertaining, and personal growth, etc. So if people already occupied with a job and they want to get improved, in most cases, they have to make an effective study plan with their own private time.

At the same time, to have a better picture of the whole situation, I also did some talks with the educators whose roles could get involved in the entire system. And they could be a kind of the end-user or the element of the process to support the whole system working. Then, their opinions and their feelings could be significant for the project.

This part I used the interview as the primary tool to explore the issue, the goal is to create some portraits for the people who could use the product and service I intend to design. And for different stakeholders, I prepared different guideline questions to give the directions of the talks.

4.2.1 Learner

Goal: To understand better the motivation of learning, how do they feel, what do they do.

Guideline core questions:

- The motivation for learning
- Method of learning
Difficulties

Feeling, experience and habits

“Cooking and gardening for me are pure enjoyment. I just check things online casually, and I create my own dish.”

Master student
Michael, Italian
PSSD graduating student

Michael is a person who has a secure connection with humanity. His hobby, cooking, and gardening, become a significant part of his life, and he always learns new things. Michael got this interest from his family. At the same time, he doesn’t like online learning without real human interaction. At the period of the interview, he was busy graduating and personal social events so that he wouldn’t devote much time to personal learning. As experienced before, he prefers a clear plan before starting and integrating study on one or two days.

**Key points:** Family impact, clear plan and time investment, human factor, priority.

**Highlight:** Programme and logic behind things

**Quote:** “Cooking and gardening for me are pure enjoyment. I just check things online casually, and I create my own dish.”
Carla loves to learn and practice archery always since she was young. And it makes herself relax. She continuously learns things from her interests like languages, yuga, sport. She decides by herself what to learn, usually quite practical and for relaxing. She would love to use fragments of time to learn. She did an online-offline course, and she really liked it, but the subject was directly related to the major.

**Key points:** Strong self-decision, relaxing-oriented, fragments time learning.

**Highlight:** Experience of Ideo course.

**Quote:** “I’m really focused, and I forget everything else when I do archery. It’s one of the favorite things in my life.”

Fig. 4.2.2 Carla is taking interview
Master student
Bob, Chinese
PSSD graduating student

Bob loves to learn, and it could be related to what he studied but also could be pure curiosity. To understand new things is an essential part of his life. He uses different media to learn, and he is glad to know what he learned is useful. But he also said one of the things he needs is the platform pragmatic and have a nice way to practice.

Key points: Curiosity, unclear goal, pragmatic platform.
Highlight: Experience with several coding online learning courses.
Quote: “I felt delighted that when I saw the paper I read was chosen to be the best papers of the year.”
“I really would love to learn and do so many things, but rationally I have to postpone them when I have enough money.”

**University administrator**

Neve, Chinese

University administrator (fashion industry), about ten years of working experience

As one of the university administrators, Neve has to deal with so many annoying things. It gives very high pressure on her. And at the same time, she wants to be successful, so she demands herself in a very high standard. What she learns is related to her job or could be useful shortly. She would appreciate the essential content of a subject and prejudice guideline. She also does something (more practice than learning) to make her calm and avoid the problem. She has a year plan to control the progress.

**Key points:** Professional related, self-demands, essential content, year plan

**Highlight:** Learn by herself guitar, calligraphy, drum.

**Quote:** “I really would love to learn and do so many things, but rationally I have to postpone them when I have enough money.”
“It may sound stupid, the challenge for me is that sometimes I really feel tired, and I couldn’t really learn something.”

Team lead
Lorenzo, Italian
Business transformation project team lead, international fashion e-commerce, over five years

Similar to Bob, Lorenzo likes to learn almost everything; it could be related to the job or just genuine interests. Learning is a way to let him better understand the world and himself. And it could also be useful for him in the future. He does a small project for his learning. For him, the most challenging thing is he often feels tired when he plans to learn something. And he really would like to have a good recommendation about what to learn.

Key points: Need for time management, life-work balance, chasing the truth, recommendation system.
Highlight: Interests in branding, blockchain project, philosophy.
Quote: “It may sound stupid, the challenge for me is that sometimes I really feel tired, and I couldn’t really learn something.”
Project manager
Johannes, German
Business transformation project manager, international fashion e-commerce, over two years in the company, part-time professional photographer

Johannes is a very pragmatic person, so it’s the same for his personal learning. If he really needs to learn something he would like to take the course and concentrate very in a specific period. But usually what he discovers are all things practical. Otherwise, he will lose the patient soon. He uses crossover knowledge to check if he understands something. And he thinks his smartphone occupy too much of his time.

Key points: Practical, distraction, concentrate learning.
Highlight: Online course experience.
Quote: “My problem is this thing (his iPhone)...this thing really distracts me.”
Insights:

- It’s essential to include the different topic can benefit both who focus on pragmatic course related to profession o just personal interest.

- The courses need to have a clear logic line to follow.

- Individual background and culture could bring different factors during the learning process. So it could be ideal to have the system can adapt to the different styles of learning.

- Psychological support and encouragement are significant for life-long learning topics.

- An excellent study plan and engaging way of learning could help a lot the whole experience.

4.2.2 Educator

Goal: To understand better as a direct stakeholder for the user, what do they think, what do they care, what do they do?

Guideline core questions:

- General working process
- Delightful/meaningful factor
- Challenge and difficulty
- Way of assessment
Young university professor
Ilaria, Italian
Communication design professor for three years

As a teacher, being followed and being understood are the most important things. She always tries to have dynamic ambient between students and her, so she usually uses different tools and interactive ways to make student focus. She does care about every student’s attention, and at the same time, it’s also a big challenge for her.

**Key points:** Real-time reaction, attention, leadership, update.

**Highlight:** Skype teaching experience, what she does with assistant

**Quote:** “I would be pretty happy that if they indicate what I said was wrong.”


Teaching assistant
Vanessa, Italian
Interior and PSS design teaching assistant for three years

As a teaching assistant, the most valuable thing for Vanessa is helping others. Still, at the same time, she feels the challenge from the communication of different generations and various communication experience. She should adjust the way of communication to adapt to the different students. At the same time, the tool and method of communication is a crucial problem for her job.

Key points: Effective communication, generation gap, efficient tools.
Highlight: Example of student failure communication and a lecture on the brainstorm.
Quote: “How to communicate with them and how to make them communicate with each other are big challenges for me!”

“How to communicate with them and how to make them communicate with each other are big challenges for me!”
Project coach
Francesco, Italian
Design thinking project coach for over two years

Francesco is a coach using his heart. What makes him most happy in coaching is the self-improvement of students -- being more confident and autonomous. He usually uses direct conversation as a way of communication and assessment method. And He appreciates close attachment with his students. So the challenge for him is how to distribute times and energy for different groups.

Key points: Empathy, communication, attachment, lifelong enhance.
Highlight: The story he told about the “best moment” way of assessment.
Quote: “I was so moved they insisted themself and proved that I was wrong! That’s what I learned from them.”
“Even he’s slow, but it’s really cool you could see he masters something step by step!”

Project coach
Yu, Chinese
Architect and Chinese language part-time teacher for two months

Yu decided to become a Chinese teacher because he needs money. But he gets satisfaction from seeing the improvement of his student. Because it’s a one-to-one class, so he has a chance to personalize for his student.

Key points: Patient, immediate response personalized progress
Highlights: Plan and personalized development.
Quote: “Even he’s slow, but it’s really cool you could see he masters something step by step!"
Insights:

- During the teaching process, feedbacks from students is essential no matter they are positive or negative.

- Communication is a very crucial factor in assessing the performance and educator and convey the information.

- Age and generation could affect the method of communication and also the way of learning.

- Based on different targets, a personalized form of teaching could be very useful during the learning process.
4.3 Current customer journey

Based on the information collected and the portraits depicted before, I generated a typical AS-IS spare time learning journey for an adult. So, as Customer Journey Map showed as below, the current journey is a decline emotional process, when a learner involves more to the ongoing learning experience, the more “pains” people could get. For an adult to learn something by themself, need powerful motivation and perseverance. Besides that, people cannot always apply what they’ve learned in the real-life, so there are not particularly positive feedback as always.

(Customer Journey Map)
4.4 Insights and conclusion

This chapter presented the process of research and analysis. From an online survey, we got the whole picture of the topic. And face-to-face interviews with different people gave several different perspectives. And then, I used the customer journey to map the current experience and try to show which part could be improved and become the point of opportunity. So, in conclusion, I put the key points to use for the next chapter as below:

**Planner:** the learner needs a good planner to guide their learning process. And make the balance of their time and different parts of self-sustainability

**Engager:** the learner needs to be involved inside the learning experience, always be encouraged and promoted, and wants to learn more.

**Inspirer:** the learner needs to be always inspired, to feel what he/she is doing is useful, and want to have a continuing motive to keep learning and discover more.
5. CHALLENGE AND CONCEPT

Based on the research the analysis from the last chapter, we identified the pain points from different stakeholders: the learners and the educators. We understand the difficulties they meet in their daily life while they process their learning activities to have self-sustainability and professional growth. So for this chapter, I would like to concentrate on framing the design challenge and then produce the practical concept.

5.1 User need and design challenge

Focusing on the life-long learning topic, from the last chapter, we understand how do an adult or a young adult learn in their spare time. What difficulties could they have when they are out of campus and entered in the society. And here I would like to summarize them into different directions, and then we can generate the HMW questions for each case.
1. The first scenario is for people who choose to learn with professional motives. Usually, the incentive starts while they face a specific problem and want to solve it. Thus for this kind of learner, their way of learning is very pragmatic: usually, they have apparent goals, and they think highly of the efficiency and accuracy. Because of these priorities, these learners would take a while to choose the right material and course, and usually, they value the most the part which can solve their problems. Sometimes they even skip or only browse the section not directly related. Then compared to other learners, they don’t create study plans in this case.

Keywords: Pragmatic, accurate, problem-solving

How might we build service for accurate professional-related learning?

Fig. 5.1.1 First scenario to generate HMW
2. From now, we will focus on the people who would like to maintain the self-sustainability. So learning is about self-development. In this scenario, for the people who have a full-time occupation, when they get home, if they want to improve themselves, they still need to spend time learning instead of relaxing or going out for social. Then, in this case, the issue they face is a functional capacity of time management and perseverance. And their learning process is missing the thoughtful guidance supported by psychological and learning theories. And a lack of feedback and recognition is one of the critical factors which creates obstacle during life-long learning. So it’s quite easy for them to abandon it after a while.

**Keywords:** Flexible, balance, motivation, habit, recognition

How might we create a platform that can promote users to have better learning plan and practice for self-development?

Fig. 5.1.2 Second scenario to generate HMW
3.1
Another situation is learning is not only about self-development. It’s part of life extension and joy. So for this group of people, they don’t need the willpower to control themselves to learn something. They enjoy learning itself. They value more about discovering new subjects and the experience of learning. So what to learn and how to learn are two core questions for them. For this scenario, learners ask for more tailored recommendations, a more engaging way of learning, and crossover knowledge connecting different areas.

**Keywords:** Casual, communication, seeking truth, independent

How might we build a system offering the tailored learning experience to extend life knowledge?

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**Fig. 5.1.3 Third direction to generate HMW**
3.2
For the add-on of the situation mentioned before, learning is part of life extension and joy. But instead of pure theory, they appreciate a more engaging way of learning to avoid distracting from other activities of life. So for this group of people, they prefer to choose to learn something by doing it, a musical instrument, gardening, or a specific kind of sport. Learning by doing, but learning for doing as well. So instead of a single way like reading or only watch videos. They would like to learn more interactively and practically, and they could enjoy the process and not concentrate on the result.

Keywords: Specific subject, immersive learning

How might we build a product service system offering the immersive training/learning experience?

Fig. 5.1.4 Last direction to generate HMW
5.2 Case Studies for the Concept

In the chapter of E-learning theory and practice, I introduced several tools and platforms. However, to help the ideation phase, I will mention some names already discussed before. For this part, I would like to present with two main sections:

The first one is to give a quick overview of the digital products and services people are using for their spare time learning;

And then, I will highlight some cases which could be useful and inspire the later design.
5.2.1 Overview of digital learning tool

1. Online resource
Use online video, forum, Q&A website, and even social media as ways to receive and learn new knowledge. Because this kind of platforms are collaborative and includes millions of users with different background and professional levels. Even they had not been designed as a learning platform, and however, because of their massive user numbers, they became significant learning platforms.

Pro
• Flexible
• Adapt to fragments of time
• Free

Con
• No structure, no system
• No practice for the real world problem
• Hard to transform into the concrete knowledge
• Not profound for the knowledge
2. MOOC
Like mentioned previously, MOOC (Massive Open Online Courses) is a very economical way to accept systemic education online. It is very similar to online university education and with a very structural program. It is one of the most popular types to learn digitally.

Pro
• Well quality-price balanced
• Top university-based
• Rich subjects to choose
• Compact and scientific structure, systematic

Con
• Fixed schedule
• Not personalized to adapt to different people
• No real-time feedback
• The form of learning materials are not engaging
• No interaction between students and tutor

Fig. 5.2.2 Most popular MOOC platform in the market
3. Online classroom

Instead of the focus on creating the whole system and full education for the users, this kind of platform concentrates on providing better online ambient to the teacher and student. As online classrooms, they offer virtual space and tools to support different types of teaching and learning activities for students, teachers, and also parents.

Pro
- Efficient communication tool
- Able to connect with other recourse and platform
- Group collaborative
- Tracking system

Con
- Close group organization
- Young students oriented
- Not always synthetic systems for different needs
- The quality of the lectures still rely on the teachers
- Not offer content
4. Gamification in learning
To increase the engagement between the knowledge and learner, so many platforms use gamification as a method. So learning things is not like a tedious task anymore. Instead, learning becomes a game. Simple, playful, and easy to get rewards. And systems were designed to make users forming a habit and right rhythm.

**Pro**
- Adapt for fragments of time learning
- Easy to get in
- Obsessed and challengeable
- Free or Affordable price

**Con**
- Single topic only
- Hard to transfer knowledge
- Content is not profound
- Lack of real-world practice

Fig. 5.2.4 Two main learning platform implemented gamification mechanism.
5. Game and quiz

Not like the gamification learning platform, some applications are games but with knowledge as support. They were not designed for really learning a subject profoundly. Their goals are more likely for brain training and enhancement of life skills and practical knowledge.

**Pro**
- Adapt to fragments of time learning
- Easy to get in
- Obsessed and challengeable
- Affordable

**Con**
- Non-academic topic
- Lack of concentrate learning
- Content is not profound
- Some knowledge is just for fun

Fig. 5.2.6 Popular quiz and knowledge game applications
6. Interaction in learning
In order to increase the engagement of the learning process and also to expand the possibility of digital devices, new ways of interaction are implemented in many applications and platforms, which allow users to learn in different ways.

Fig. 5.2.7 Example of education platform with enhanced way of interaction.

Devices as experimental tools

Use VR to enhance the experience

Social and community

AI and natural language
7. Behaviour and habit
Creating habits and focusing on learning/working is also a big topic for the application market. It could be very directly affected by the performance of learning and working. How to encourage people to focus? How to make people insist on doing something until it becomes a life habit? How to help people doing time management? We can find the apps easily to correspond the questions like these. However, on the market, there are no outstanding products that can combine time management, habit training, or meditation into the learning process. They were launched as single independent tools usually.

Fig. 5.2.7 Application for forming the habits and good lifestyle.
Conclusion
As a conclusion for this part, I put all the products I mentioned above on a coordination map to make an analysis. We can easily understand that now in the market, there are not so many services and platforms focus on offering multi subjects of knowledge and, at the same time, possessing an engaging way of learning (see map page after).
5.2.3 Analysis highlight case

1. Seesaw

**Keyword: Tool, Stakeholders**

Seesaw is a product system for students, teachers, and parents. It provides powerful auxiliary tools to support teachers making online teaching activities, and at the same time, parents can easily trace and monitor their children. There are tools for communications, for video, for drawing graphics, for submitting the material, for assessment and tracking the performance, etc.

**Students show learning**

Students use built-in annotation tools to capture what they know in Seesaw’s digital portfolio.

**Teachers gain insights**

Teachers deeply understand student thinking and progress — enabling them to teach better.

**Families connect**

Families gain a window into their student’s learning and engage with school happenings.

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Fig. 5.2.9 Seesaw student application interface and parents communication example.
2. LinkedIn learning

Keyword: Personalized, Professional

LinkedIn Learning is a platform based on the professional social network LinkedIn. A large part of LinkedIn Learning is based on Lynda content and goes live with some 9,000 courses on offer. Subjects taught through the service include business, technology, and creative topics, with courses running the gamut from programming skills to writing and accounting.

Courses can be both selected by employees as well as recommended by employers and their HR managers who can use LinkedIn’s analytics products to both monitor employee’s progress but also look at the broader range of what is being studied as a point of reference, and curators at LinkedIn itself.

Because of the close attachment with LinkedIn, LinkedIn Learning offers the certification and connecting with professional skills listed on the CV profile. It makes the system more convenient to personalized for the users. And it would increase the possibility for the users to get motivation from the service.

Fig. 5.2.10 LinkedIn learning interface: certification, learning path and plan
3. MasterClass

Keyword: Content, Reputation

MasterClass is an American online education platform. Students can access tutorials and lectures pre-recorded by experts in various fields. As in most online education, the classes are not interactive, though at least one course included “interactive assignments” where the student acted with other students, either in person or over Skype.

MasterClass produces online classes with “renowned personalities in their respective fields.” Each class has video lessons, exercises, workbooks, and interview sessions with the instructor. A typical class has about 10–25 video lessons that are two to five hours in total.

Classes cover topics like writing, sports, and cooking. As of 2019, the company was expanding into politics, economics, and video game design. Many instructors do live demonstrations if the topic is easy to illustrate visually, while writers lecture.
4. Fabulous
Keyword: Habits, Storytelling

Fabulous is an app available for both the Android and the iPhone that helps users track habits and create routines. The app is based on the concept of ‘journeys.’ Each journey allows you to set a routine up in small steps. The first, free routine is all about the morning and sets yourself up for the day. The very first habit is small and simple: drink a glass of water upon waking up.

Over time, it adds more habits, chaining them together to create a complete routine. You can also customize the routines and add habits of your own choice into them.

An alarm triggers each routine at a time you specify. You can set your morning routine to start at 6 am, your afternoon routine to start at 1.30 and your evening routine to start at 7 pm.

Like I mentioned before, habit and behavior are crucial factors impacting how people learn things. That’s why I select this application as part of the case study.
5. Keep

Keyword: Gamification, Community

Launched in February 2015, Keep is like a fitness trainer in your pocket: It offers a variety of personalized training courses that let you work out anytime, anywhere. It’s also social, so users can follow each other and share their workout progress to other social media platforms.

Using gamification and social-engagement strategies, Keep continues to involve more and more people in the social network to join the platform. Workout star, trainer, community, personalized course, IoT, encouragement of creating routine and forming of habits, all these factors bring success to this product.

Keep announces in 2017 that it has reached 100 million registered users and claims it’s the first Chinese fitness app to achieve this milestone.
5.3 Concept

From this thesis, we put the theories on learning and artificial intelligence as a start point. And then, with survey research and interviews, we understood the concrete needs and difficulties when people facing the topic: what to learn, why to learn, and how to learn. And based on that, we began to generate various directions and possible scenarios for life-long learning, and we got several “How Might We” questions which formed the design challenge.

Focused on the topic and possible features, we also did benchmark research for the products in the market. We divided the different products and services into different categories, and we highlighted some of them, which could impact the later ideation part.

So based on the design challenges, previous research, and some analysis of case studies, we arrived here: creation of the concept. In this phase, I chose Brainstorming as a design thinking tool and Mind Map as the outcome also to lead my final thoughts. Then I started with the core idea: Lifelong learning in spare time. So I structure the challenges into four different factors, the data and Artificial Intelligence and technologies will support the system in four parts:

**Determination and perseverance**, which are essential qualities to support all kinds of users to have professional growth or self-sustainability.

**Adaption**. It allows people to use the platform and service quickly and conveniently.

**Time management**. One of the critical factors all the people have to face, especially when they step into society.

**Engaging process**. If an experience is pleasant, that means people like to use it. If people use it, there is a chance they learn. Learning is not an easy thing; that’s why this platform has to be attractive and engaging.
These four aspects are correlated, and with the help of Mind Map, I illustrate how they can extend and become more concrete ideas and apply for the future system. With visual language, layered by layer, we can have a glance at the general look of the future product.
These four aspects are correlated, one affects others. With the help of Mind Map, I illustrate how these aspects could extend and become more concrete ideas and apply for the future system. With visual language, layer by layer, we can have a glance at the general look of the future product.

Fig. 5.3.1 Concept mind map
elevBeat! A lifeline system accomplishes to learn, to grow, to meet your learning companion, and meet yourself.

With the help of Intelligence and mechanism, it helps have an engaging personalized learning experience.
long learning experiences you to discover, to learn and to prove

of Artificial and gamification helps users to learning and learning
6. SERVICE DEVELOPMENT

This chapter will introduce step by step how the service “elevBeat!” system was designed. And in order to explain clearly, I divided it into several stages, and for each stage, I used different design tools. With Service Offering map, I illustrated all the core service offerings should be included in the system. Then I set two personas to introduce the possible journey. Then instead of Customer Journey, I used Service BluePrint. It provides a better vision of activities from different stakeholders and how it would work from the backend. Then focused on the website on the level of product, I designed the website offering map and architecture. And for the next chapter, I will introduce the wireframe part as the prototype.

6.1 Offering Map

The offering map is the tool to define what services a product system providing to the users, based on the value proposition, it details the system into more specific clusters of features. How to use the offering map is depended on the service complexity. The offering map can be very articulated, showing distinct macro-areas of the offer, and then narrowing them down into more specific areas and functions.

From the concept generated from the last chapter, we got the core value proposition of “elevBeat!”, based on these values, we could create more concrete features. And then, these features will be profounded layer by layer to get a more sophisticated result.

There are five core features mentioned below:

- Mass learning
- Community
- Schedule tool & Habit tracker
- Artificial intelligence
1. **Mass learning community**
The system should be a mass system to support the function of artificial intelligence. At the same time, it could be a maximum reduce the price for the different users and offers a variety of courses. On the other hand, the property of the community will bring a sense of belonging and secure attachment from the system and users.

2. **Schedule tool & Habit tracker**
Lifelong learning is a topic for the long-term. So building an excellent habit is an essential point, especially when people learn by themselves. It not only about time management but also psychological training. Then schedule tool and habit tracker becomes one of the core features.

3. **Artificial intelligence assistant**
It’s the core factor of the project, which supports the system having an intelligent, personalized experience for the entire journey. It will be applied to different aspects.

4. **Knowledge portfolio**
The knowledge portfolio is part of performance and assessment in the system. At the same time, it could continuously encourage people to learn to record, and finally, these experiences can be shared with the real world to have concrete benefits.

5. **Visualization & Gamification to promote**
The modern society has a very rapid rhythm, and it’s the same also for education. So the service should be engaging for the users, so also for elevBeats! Its gamification mechanism involves the people to keep learning and discover new.
Fig. 6.1.2 Service offering map
Intelligent Recommendation
Intelligent Matching
Intelligent Feedback
Knowledge archive
Learning trace record
Course Learning Path
Learning Mates
Review
Virtual currency
Community rate system
Mission system
Encourage & Motivation
Engagement
Visualization & Gamification to promote
Artificial intelligence Assistance
Knowledge portfolio
6.2 Service Blueprint

A service blueprint is a diagram that visualizes the relationships between different service components — people, props (physical or digital evidence), and processes — that are directly tied to touchpoints in a specific customer journey. Compare to the customer journey, and it offers more rich information from the frontend also to the backend.

For this part, introduced the service blueprint by three parts. The protagonist I'll use personas as a stater, and then the main blueprint segment in different pages and then some profound information to build the service.

6.2.1 Personas
Giuseppe
Active learner

32 years old. Italian. Digital marketing project manager. Had education and working experience in UK. Have a girl friend for 5 years. He loves his job but sometime it makes him exhausted. Full of curiousity. Love reading, dog, movie, science and technology. For him, understanding theory and system behind makes him happy. He doesn’t like to waste time on boring things. Sometimes enjoy being alone and just get along with himself. But he is also a person would like to share. He is good organizer for his job, but not for his life.

Frustration:
/Sometimes he doesn't have enough motivation to learn.
/It is too hard to find what the right things to learn, there are too many things to choose in this digital age.
/It should spend a lot of time to collect the different material for the same topic from various channel.
/Organizing his own study plan in his life is not an easy things.
Alice
New Adaptor

23 years old. French. Female.
Junior graphic designer working in a fashion company.
Love travel, and had experience for Erasmus.
Single.
Graphic design as one of living option, but she thinks there’s still a lot of opportunity in the future.
She loves social in general.
She continually looks for the direction of the life.
Career is very important part of her life. And she keeps learning new things to improve her competitiveness.
She has a general idea what she wants to be, but in detail she needs guidance.
She’s very curious and open minded. She always set goals for herself to achieve.

Frustration:

/Sometimes social life takes her so much energy and makes she feel meaningless.
/If the platform for learning is too complicated she would give up soon.
/It’s very hard to find a right path for what she needs to learn.
/She’s easy to get distracted by different things in life.
/She feels annoying when she needs to collect right material before she really learn specific things for specific task in limited time.
/There’s no platform to trace her improvement and her learning path.
6.2.2 Service Blueprint

User

<table>
<thead>
<tr>
<th>Line of interaction</th>
</tr>
</thead>
<tbody>
<tr>
<td>Register and create professional profile</td>
</tr>
<tr>
<td>Ask for becoming an instructor</td>
</tr>
<tr>
<td>Read the guide and check the examples</td>
</tr>
<tr>
<td>Check the system report for specific professional topic</td>
</tr>
<tr>
<td>Create course with guide</td>
</tr>
</tbody>
</table>

Instructor

<table>
<thead>
<tr>
<th>Line of interaction</th>
</tr>
</thead>
<tbody>
<tr>
<td>Register and create professional profile</td>
</tr>
<tr>
<td>Ask for becoming an instructor</td>
</tr>
<tr>
<td>Read the guide and check the examples</td>
</tr>
<tr>
<td>Check the system report for specific professional topic</td>
</tr>
<tr>
<td>Create course with guide</td>
</tr>
</tbody>
</table>

Detail Touchpoints

<table>
<thead>
<tr>
<th>Line of visibility</th>
</tr>
</thead>
<tbody>
<tr>
<td>Generate the popular and related topic and question to instructor</td>
</tr>
</tbody>
</table>

System Technology

<p>| |</p>
<table>
<thead>
<tr>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Generate the popular and related topic and question to instructor</td>
</tr>
</tbody>
</table>

Before

<table>
<thead>
<tr>
<th>Choose the interesting topic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Check the learning profile page</td>
</tr>
<tr>
<td>Discover the courses and community</td>
</tr>
<tr>
<td>Search the course/topic</td>
</tr>
</tbody>
</table>

Search the course

<table>
<thead>
<tr>
<th>Prepare the individual data</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Generate the result course/path use AI</td>
</tr>
<tr>
<td>2. Record searching history</td>
</tr>
</tbody>
</table>

Prepare the individual data
1. Notification push up from personalized community. Record behaviour.

2. Chatroom with space and whiteboard.

3. A.I. system for revising.

- Do revision for students.
- If no, ask for connecting to instructor.

4. A.I. system for assessment.

- Share in community.
- Share on social network.

5. System update the data and visualized status.

During:

- Read related material.
- Check and discuss with learning partners.
- Ask for revising problems.
- Take exam and present outcome.
- Finish and get reward.
- Check the learning status.

After:

- Review and answer questions for others.
- Write an article.
- Share link, source, ideas.
- Loan book.
- Follow the people.
- Get learning life scores or reward.

- Check system report and analysis.
- Different features in community and learning profile.
- Reward and score connect to benefits.
- Interpret visually in profile.
6.2.3 Profound analysis

What A.I. can do in the system?

To find a good course

To find a good learning path

To match some good learning mates

To optimize the schedule and reminders

To push a related learning material (notes, article, ideas)

To check the homework and tests

To do a simple review

To push a good answer for specific question

To recommend challenges/books

To assess the outcome of challenges

To elaborate personal knowledge community feeds

To summerize the feedback to instructors

What kind of data system collect?

Users’ profile and background informaiton

Users’ community behaviour and characteristic (like, repost, comment and other activities)

Users’ learning behaviour (speed, notes rate, media preference, efficiency)

Users’ learning schedule preference (learning time preference, )
Who could be followed in the system?

The instructors with courses
Knowledge community activists
Learning models/masters
Friends and people in social network
Learning mate

What is learning path?

Learning path is combined from different courses to reach the specific goal. It’s could be an series of knowledge points in order.

Gamification

Streaks
Learning hours
Likes
Finished challenges

\{ Learning life, Learning diamonds \}

Reward (To exchange to discount, offer, privilege)
“Punishment” (expel)
6.3 Website Offering Map

We started from the service offering map to profound the value proposition of the concept. Now, after the service blueprint, we already have more concrete ideas about how this system would be. So I use offering map again, but this time, we focus on the website. One of the essential parts of the system. So the service offerings now will be adapted to the website structure and will be presented in various features. Because of the complexity of the website, for the web offering parts, I would like to introduce them separately with functional area blocks.
My effort, Discovery and Enlightenment as three main important section of the website. "My effort" contain all the trace and publiccantion on the website. "Discovery" is the area for new material and topics. It is section for learning community. And "Enlightenment" is part for social network, it more relax. You just could learn from some sharing from others.
Fig. 6.3.3  Web offering map part 3

Enlightenment
(Social network about learning, and information of interesting topic)

- People to follow
  (Recommended user to follow with similar interests or SN friends)
- My Archive
  (Short cut to check my library, my article, score, etc.)
- Recommendation
  (the system recommends for me the useful materiel)
- My network
  (Sharing knowledge, activities from my follow)
- Create new "thoughts"
  (Sharing my knowledge or opinion)

- Article
- Thoughts
- Learning material
  (notes, summerize, outcome)
- Activities

- Article
- Tweet
- Link
- Photo/video
- Audio
- Repost
Searching engine

- Recommendation of course and learning path
- Recommended posts, article notes...
- Filter for media and learning style

Message & notification

- Learning group chat
- Other chat
- Notification

My account

- Apply to become an instructor
- Get help and assistant
- Profile configuration
6.4 Website Architecture

Fig. 6.3.1 Architecture Website P1
Fig. 6.3.2  Architecture Website P2

- Home
- Searching Engine
  - Related recommended courses
  - Related recommended learning paths
  - Related posts, thoughts, articles, people
  - Searching filter
- Message & Notification
  - Learning group
  - Chat
  - Group drive
  - Whiteboard
  - Chat
  - Notification center
My account

- Ask for becoming an instructor
- Help center
- Profile configuration

Other people’s profile

- (similar like Ómy effortÓ)
- Followe +
- Private message
7. PROTOTYPE AND TEST

I made the prototype weighing on the functionalities, so I only created the wireframe. So the users can focus on the idea, logic, and features behind. I only did a small test with friends. The feedback was positive, especially with the concept, and also, it’s easy to follow the flow I set. For them, the doubt is on implementation and if it’s possible to do.

Fig. 7.1 Prototype onboarding flow p1

After registration. Choose the preference topics as starting point for elevBeat.

Insert the real credential information for creating the reliable profile for the system.
Enter to “my effort” to check all of the features related to me and my learning trace.

Go to discovery the new course in "discovery" area
Plan and enrol for the course. Then pay to the course.

Fig. 7.2 Prototype onboarding flow p2

Check the course details and the offer for the user.

Plan and enrol for the course. Then pay to the course and get the offer.
Check and match the mates for learning the course.

After confirmation, User is back to "My effort" area and prepare to learn.
Click for daily course plan and use popping up page to learn the different sections. It shows the format and time of the course. There are several functions supporting during the course like take notes, borrow book etc. (mobile and responsive)

My effort area. The dashboard shows activity and the main portal for the personal service(mobile and responsive).

Go to learning mates channel to check the action and can get the overview (mobile and responsive).
The course setion from “discover” area. Besides the recommending courses, the user can find different course according to his/her own interests and social network.

The challenges section from “discover” area. It’s the area encouraging the user to practice and apply what they learned. The content is based on the users' data.

The Q&A section from “discover” area. It’s the forum allowing the users to collaborate learning and to help each other. The posts are also elaborated by AI algorithm.
Enlighten area. It’s the part for users to access and create social network content (article, thoughts, photo, video etc...), the feed will be relied on the behaviors of users: the topics he/she likes or learns.

The learning mates tools for the learning group also can use the board function allows the group to work together.

The tool allows group mates to draw on the board in real time, it’s easier to make communication in most content areas.
chat area. The area offers the different thing group. Besides the chat, the mates board, call to revision function. The drive group to use cloud drive to work.

Based on the user data and system Ai algorithm, the system uses push notification to guide user to form the learning habit according to their own situations. It also offers the personalized short lessons and intresting posts to users with the help of Ai.

Fig. 7.4 Website and mobile structure p2
8. CONCLUSION

elevBeat! The mass lifelong learning platform based on AI was a nice trial. It gave me the chance to have a deep understanding of a technology that appeared in recent years. It was an opportunity to do some research on education and learning. The most important is that it was a really nice conceptual project to really combine these two objects together and create something new with the help of design thinking methodology. Discover the problem and understand the needs. Study and understand how the technology could work. Every step was meaningful. Finally, I designed a possible proposal for the market. Unfortunately, because of the fail of time management and personal plan, this project didn’t reach its best possible result. And at the same time because of time flying, so many things are a little bit behind. But I still believe there is still potential to discover this topic, and I believe elevBeat! was a good try from technology, learning theory, social connection, community, and gamification to solve the current situation affront of the topic of lifelong learning. Because of the COVID-19, we could see the opportunity and grand possibility for this topic. And I believe in discovering, in learning, and keeping growing will accompany us for our whole life. So if there will be a chance, I will still discuss this topic under real-world circumstances.

So what could be the next steps:
• Do the proper prototype test to understand if the product really meets users’ needs.
• Consult for expert, try to implement in a small area.
• Finish the high fidelity interface design and prototype, at least make it like a proper product.
• Keep tracking the new technology and human behaviors. It could impact how people could learn things.
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Ciao per quanto tempo! Ci vediamo tra poco!
2020