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# Using learning style instruments for MOOCs

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## Abstract

Over the past twenty years, Online learning and Education Technology have emerged as one of the most potential tools in offering quality education and massive training to a huge domain of audience worldwide, several models of learning style have been proposed and have increasingly drawn attention to improving the process learning of learners. On one hand it reaches a global domain of learners, and on the other hand promulgates knowledge in an efficient digital platform, besides intertwining a huge network of students, scientists, professors, scholars, teachers and different stakeholders related to education. Learners that are involved in this learning environment are heterogeneous so they have different characteristics, preferences, levels, different backgrounds, abilities and needs.

Therefore, it is not appropriate to use the same learning styles for each learner. The neglect of adaptation to the learner's profile and preference prevents a high level of understanding of content learning. Adaptation of learning styles has become a very interesting subject in recent research; since it opened the possibility of incorporating different methods into E-Learning to improve the process of delivering learning materials and constructing an environment that elevate the learner's potential. Our main goal is to use learning style instruments from Felder - Silverman, Kolb and Neil Fleming models to improve and provide a proper learning to each learner.

**Keywords**— Online Learning, Education Technology, Adaptation, Learning style .

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# General Introduction

Online Learning Systems have offered many advantages in the educational setting and today's life is greatly influenced by the development of technologies, especially Information and Communication Technologies (ICT) where learners can learn from where they want and when they want in real time, unlike traditional learning methods. However, these systems offer a large amount of data due to this fact. The user is confronted with an information overload in which it is difficult to distinguish relevant information from secondary information. Also they do not offer personalized services, since all learners have access to the same set of learning resources, without taking into account the diversity of their capacities and their skills. These obstacles have pushed researchers in the field to develop adaptive learning systems that cause autonomous adaptations to the user's model for presenting content that is relevant to the user's needs. This push revealed a new mode of distance learning known as Massive Online Open Courses (**MOOC**) on the internet, which made learning really fast and efficient with a minimum of problems: saving time, saving transport and accommodation costs, flexibility of use, interactivity.

However, the quality of adaptation of these systems is not always adequate to the needs of the learner in terms of the offered educational service because it might not take into consideration the individual preferences of learners. It is necessary to consider **learning style instruments** as tools to pinpoint the learner's preference in order to maximize their satisfaction by learning. We find that the majority of the work carried out uses only one model of learning style therefore the relevant learning style of the learner will not be detected precisely. For this we have implemented multiple learning style models.

This thesis presents an adaptive learning system and in functions of the learning style, using a combination of two learning styles models as a criterion for adapting an online course and information processing, and a behavior detection model based on a third learning style model.

Our thesis is organized into 4 chapters:

- The first chapter presents the concepts related to E-Learning, as well as the theory of learning and some E-Learning platforms.
- The second chapter is devoted to the presentation of **MOOCs** as adaptive learning systems with the models used, and some examples of adaptive learning systems and their relevance in the past year due to the pandemic caused by the **COVID-19** disease. Also presenting the related concepts to **learning styles** and adaptation dimensions. This chapter emphasizes the value of using learning styles in adaptive learning systems and the quality of adaptation offered by taking into account the learning style of the learner, to showcase this we will review some related works to get a wider idea of how MOOCs can be interpreted.
- The third chapter presents a conceptual view of our system. Justifying the choice of the learning style models, Fleming, Kolb and Felder-Silverman model. Also showcasing the playing factors and their interactions within the system.
- The last chapter presents the tools used in the implementation phase and an overview of the results obtained.

# Chapter I

## E-LEARNING

### I.1 Introduction

Web-based learning is used nowadays as another option to face to face education. As a matter of fact, its use increases in a direct proportion with the increase of the number of students. This has made educators exert a lot of effort to help the learners to get interactive content that is full of multimedia as it has been proven that it has a significant effect on the process of learning. The impact of blogs and wikis has also been investigated on learners' collaboration and reflection and it was reported that they both have a positive effect. [1] Research examining the effectiveness of e-Learning has increased in recent years. This is primarily due to the increased possibilities for IT and learning as well as increased political and organizational attention to 'what works' in learning. [2]

This chapter is structured around three research questions: How can E-Learning be defined? What impact has E-Learning made to the education industry? What benefits did E-Learning bring to the students compared to traditional learning?

### I.2 E-LEARNING: Definition

The term e-learning comprises a lot more than online learning, virtual learning, distributed learning, networked or web-based learning. As the letter "e" in e-learning stands for the word "electronic", it would incorporate all educational activities that are carried out by individuals or groups working online or offline, and synchronously or asynchronously via networked or standalone computers and other electronic devices.[3]

E-learning can also be defined as the science of learning without using paper printed instructional material. E-learning is the use of telecommunication technology to deliver information for education and training. With the progress of information and communication technology development, E-learning is emerging as the paradigm of modern education.[4] E-learning is not only about training and instruction but also about learning that is tailored to individuals. It includes the delivery of content via Internet, Intranet, and Extranet, satellite broadcast, audio-video tape, interactive TV and CD-ROM. Nonetheless, the different terminologies point to a similarly conceived educational experience.[5]

## **I.3 History of E-Learning**

The term “E-Learning” has only been in existence since 1999, when the word was first utilized at a Computer Based Training (CBT) systems seminar. Other words also began to spring up in search of an accurate description such as “online learning” and “virtual learning”. However, the principles behind e-learning have been well documented throughout history, and there is even evidence which suggests that early forms of e-learning existed as far back as the 19th century [24]

### **I.3.1 The Evolution of E-Learning**

E-learning has its origins from mail-learning method through correspondence courses. Sir Isaac Pitman’s mail courses used shorthand technique to teach in 1840. It has said to be the first distance learning course. The concepts remained the same throughout the history, but medium multiplied as the technology developed. [25]

Evolution of distance learning can be described as an inconsistent pedagogy method which uses unconventional, conventional and new communication medium to deliver instructional material without any geographical constraint. Since distance education began its course, authors and academics have diverse definitions for it. Content delivery format for distance education have taken various forms such as mail delivered instructions, materials in print format, classes over electronic medium, via mobile devices and now, virtual classes.[25]

In 1924, the first testing machine was invented. This device allowed students to tests themselves. Then, in 1954, BF Skinner, a Harvard Professor, invented the “teaching machine”, which enabled schools to administer programmed instruction to their students. It wasn’t until 1960 however that the first computer based training program was introduced to the world. This

computer based training program (or CBT program) was known as PLATO-Programmed Logic for Automated Teaching Operations. It was originally designed for students attending the University of Illinois, but ended up being used in schools throughout the area.[24]

In the early 1990s, many companies were using videotape-based training for their employees. The idea of putting training on video was a good idea, though it was lacking in a few areas :(1) Customization based on needs of users, (2) Expensive to maintain and (3) Could not be upgraded easily. There is also the issue of employees having to hunt down the proper equipment in order to watch the videos. These videos often had limited interactions which lead to the nearly impossible task of tracking progress and assessment.[26]

With the introduction of the computer and internet in the late 20th century, e-learning tools and delivery methods expanded.[26] One of the first innovations in actual e-learning was the LMS or Learning Management System. This enabled schools and companies to place courses online and be able to track students' progress, communicate with students effectively and provide a place for real-time discussions.[26]

### **I.3.2 Online Learning Today**

E-learning involved the virtual learning environment, so called. VLE (Virtual Learning Environment), a costly software whose purpose is to establish a structure around the courses, work plan and testing. Students are active participants who share ideas, solve outstanding problems, using different sources of informations together and create new knowledge.[27]

A new educational phenomenon emerged in the last decade enabled by the e-learning technology and initiatives known as MOOCs. MOOCs (Massive Open Online Courses) aim at free, massive, online education system comprising open-access and self-learning method courses.[25]

E-Learning 2000	i E-Learning 2010+
Found distributed knowledge	Generate new knowledge.
More E-Tutoring	In possession of a student.
Students can be isolated	Creates a learning community.
Comes from provider/institution	The tool is to support partnership.
Ignores the context of students' prior knowledge	Builds on students' prior knowledge and context.
Suppresses students' creativity	Stimulates students' creativity and strengthens the spontaneous dimension of learning fun.
Pushes the roles of teachers and trainers	Enriches the role of teachers and trainers.
Focuses on technology and content	Focuses on quality, process and context of learning.
Privileges to those who had taught before	Interventions and motivate those who have been taught.

Table I.1: The evolution of E-Learning over the past 10+ years

## I.4 Learning Theories

- Behaviorist Learning Theories:** The origins of behaviorist learning theories may be traced back to the late 1800's and early 1900's with the formulation of "associationistic" principles of learning. The Behaviorist Theory is concerned with the study of observable behaviors; it draws its origin from the pioneering research of physiologist Ivaan Pavlov's Conditioned response theory.[27]Pavlov rang a bell when he gave food to the experimental dogs. He noticed that the dogs salivated shortly before they were given food. He discovered that when the bell was rung at repeated feedings, the sound of the bell alone (a conditioned stimulus) would cause the dogs to salivate (a conditioned response). Pavlov also found that the conditioned reflex was repressed if the stimulus proved "wrong" too frequently; if the bell rang and no food appeared, the dog eventually ceased to salivate at the sound of the bell.[28]

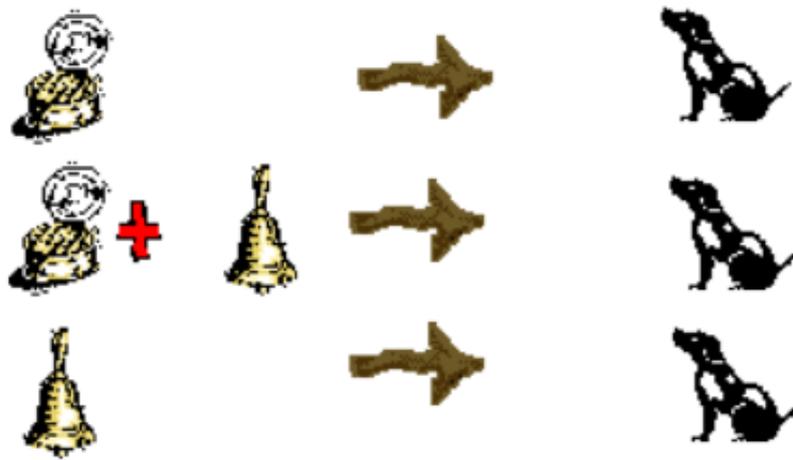


Figure I.1: The experiment of Ivaan Pavlov-1890

Using behaviorist theory in the classroom can be rewarding for both students and teachers. Behavioral change occurs for a reason; students work for things that bring them positive feelings, and for approval from people they admire. They change behaviors to satisfy the desires they have learned to value.[28]

- **Cognitive-Constructivist Learning Theories:** Constructivism is the theory that says learners construct knowledge rather than just passively take in information. As people experience the world and reflect upon those experiences, they build their own representations and incorporate new information into their pre-existing knowledge.

From his observation of children, Piaget understood that children were creating ideas. They were not limited to receiving knowledge from parents or teachers; they actively constructed their own knowledge. Piaget's work provides the foundation on which constructionist theories are based.[28] Jean Piaget's theory of cognitive development suggests that children move through four different stages of mental development. His theory focuses not only on understanding how children acquire knowledge, but also on understanding the nature of intelligence [29]. Piaget's stages are:

- Sensorimotor Stage: birth to 2 years
- Preoperational Stage: ages 2 to 7
- Concrete operational stage: ages 7 to 11
- Formal Operational stage: ages 12 and up

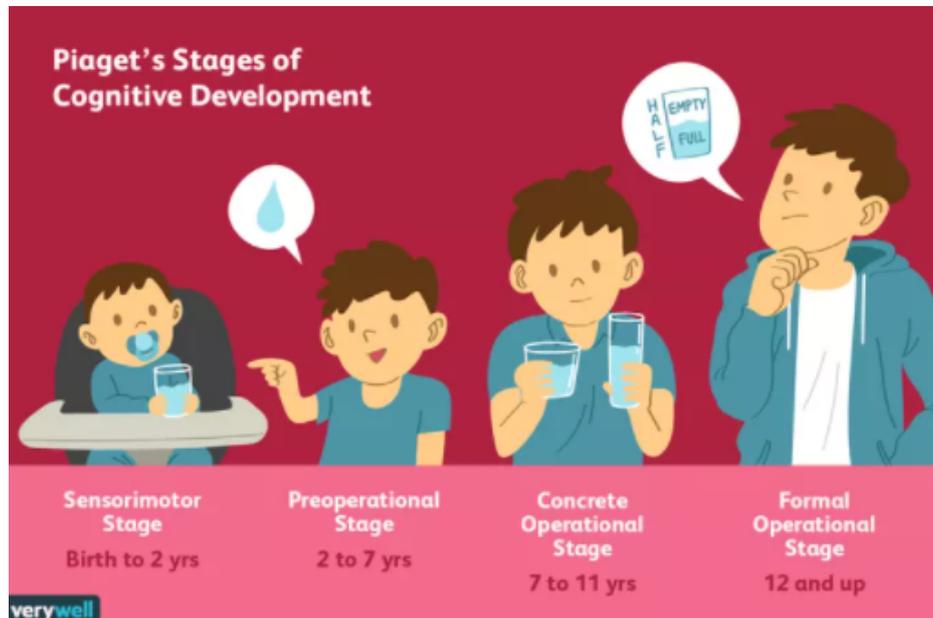


Figure I.2: Piaget's Stages of Cognitive Development

Piaget believed all children pass through these phases to advance to the next level of cognitive development. In each stage, children demonstrate new intellectual abilities and increasingly complex understanding of the world. Stages cannot be "skipped;" intellectual development always follows this sequence. [28]

- Social Constructivism Theories:** Social learning theory, proposed by Albert Bandura, emphasizes the importance of observing, modelling, and imitating the behaviors, attitudes, and emotional reactions of others.[31] For instance, students learn primarily through interactions with their peers, teachers, and parents, whereas teachers stimulate and facilitate conversation through harnessing the natural flow of conversation in the classroom.[30] Social constructivism teaches that all knowledge develops as a result of social interaction and language use, and is therefore a shared, rather than an individual, experience. [32] With the primary focus on the students' understanding of the discussion. Social learning is commonly referred to as observational learning, because it comes about as a result of observing models. Early theories considered behavior to be a function of the person and their environment, or a function of the interaction between the person and their environment. Bandura believed that behavior itself influences both the person and the environment, each of which in turn affects behavior and each other.[28]

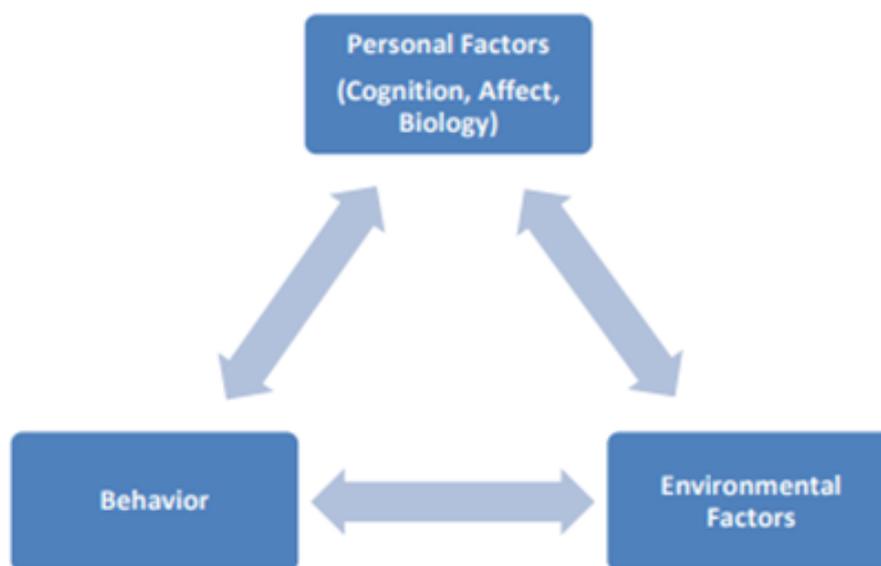


Figure I.3: The cognition–affect–conation model

## I.5 Traditional Learning VS E-Learning

E-learning gives us the advantage of 24x7 and 365 days a year round access as compared to Instructor-Led Training (ILT), which is one time class which must be scheduled. E-learning is convenient to learner in comparison to Traditional Learning which has scheduling conflicts and inconvenience [4]. The virtual e-learning education provides students that could work within their home without going anywhere and without stress so the students are able to save their times and unnecessary traveling charges [33].

One advantage of Traditional Learning has over E-learning is the physical presence of instructor in a classroom, who can solve the queries of students instantly and can motivate the students to enhance their performance. E-learning provides students to learn at their own speed, but in Traditional Learning students are pushed through course in specific time frame, also ILT is not self-paced.[4]

<b>Traditional Learning Process</b>	<b>E-Learning Process</b>
Face to Face attendance	Use of Multimedia as communication type.
Lecturer are follow up all participants	Use of online Technology
Lecturer are real in the class	Sharing knowledge between peer-students and with lecturers
Time distributing shortly between big number of learners	Time free in addition to location and when they connected
Lecturer focus on acquisition of "Knowing"	Lecturer focus on skills and acquisition of "doing"

Table I.2: Traditional Learning VS E-Learning

## I.6 Types of E-Learning

### I.6.1 Synchronous E-Learning

Online Synchronous learning can be defined as: a real time, instructor-led online learning event in which all participants are logged on at the same time and communicate directly with each other. In this virtual classroom setting, the instructor maintains control of the interaction with the class, with the ability to "call on" participants. [6] Synchronous E-learning, commonly supported by media such as videoconferencing and chat, has the potential to support e-learners in the development of learning communities. Learners and teachers experience synchronous E-learning as more social and avoid frustration by asking and answering questions in real time.[34]



Figure I.4: Synchronous E-Learning

## I.6.2 Asynchronous E-Learning

Asynchronous learning can be defined as: learning in which interaction between instructors and students occurs intermittently with a time delay [6], meaning it allows learners to access information whenever they need and to be more independent in their learning process, classes can be recorded, edited and stored for later playback, instantly creating self-paced content for student review or for instructor training.

Asynchronous E-learning makes it possible for learners to log on to an e-learning environment at any time and download documents or send messages to teachers or peers. Students may spend more time refining their contributions, which are generally considered more thoughtful compared to synchronous communication.[34]



Figure I.5: Asynchronous E-Learning

## I.6.3 Blended Learning

Classes can be recorded, edited and stored for later playback, instantly creating self-paced content for student review or for instructor training.

“Blended learning” designates the range of possibilities presented by combining Internet and digital media with established classroom forms that require the physical co-presence of teacher and students’. [7]

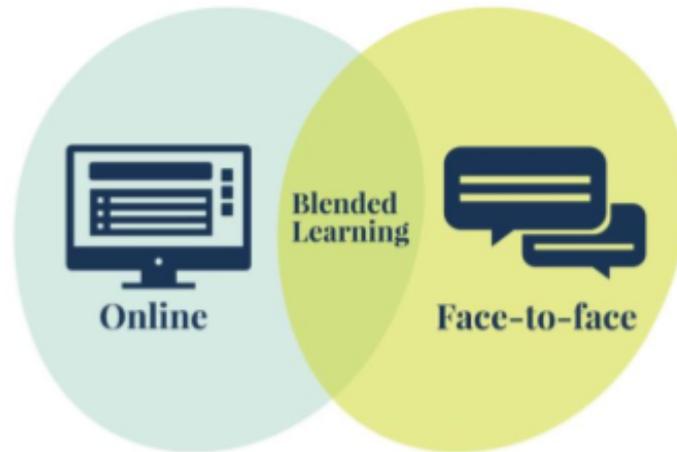


Figure I.6: Blended E-Learning

#### I.6.4 Microlearning

All materials are split into short and easy to digest learning bites. Learners and participants can take 5-8 minute courses on their own mobile devices anytime they need.

## Micro Learning

Micro learning is learning in small steps



Figure I.7: Microlearning

## I.7 Platforms of E-Learning

E-Learning platforms are improving by the day, among the E-platforms we can distinguish the most used:

- **Skillshare:** Skillshare is one of the most popular online learning platforms. It has a massive collection of over 20,000 classes that are divided into three categories: Thrive (Lifestyle, Productivity), Build (Business Analytic, Freelance Entrepreneurship, Leadership Management, Marketing), and Create (Animation, Film Video, Graphic Design, Music, Creative Writing, Photography, Web Development, and more). [36]
- **LinkedIn:** LinkedIn offers thousands of high-quality courses for all levels, from beginners to advanced, covering a wide array of subjects, including Web Development, Software Programming, Economics, and Business Management. [36]
- **MasterClass:** MasterClass is an online learning platform that everyone is talking about. What makes it different is that the courses are taught by world-famous experts and celebrities. You can learn acting from Natalie Portman, film-making from Martin Scorsese, singing from Christina Aguilera, cooking from Gordon Ramsay, writing from Dan Brown, etc. [36]
- **EdX:** edX is one of the best providers of college-level online courses. The company was founded by Harvard and MIT, and the quality of courses is top-notch. All the courses on edX, with the exception of professional education courses, can be taken for free. [36]
- **Futurelearn:** Futurelearn is an online education platform that offers hundreds of courses from the world's leading universities. The majority of courses can be audited for free, but access to course tests and a Statement of Participation or Certificate of Achievement becomes available only if you upgrade to a paid course. [36]

## I.8 Advantages of E-Learning

E-Learning has completely transformed the way in which learning is imparted to students. Unlike traditional chalk and board method of teaching, E-Learning makes learning simpler, easier, and more effective. Here are some features of E-Learning that make it advantageous to students:

- The online method of learning is best suited for everyone. This digital revolution has led to remarkable changes in how the content is accessed, consumed, discussed, and shared. Online educational courses can be taken up by office goers and housewives too, at the time that suits them. Depending on their availability and comfort, many people choose to learn at weekends or evenings. [19]
- Unlike classroom teaching, with online learning students can access the content an unlimited number of times. This is especially required at the time of revision when preparing for an exam. [19]
- E-learning enhances the efficacy of knowledge and qualifications via ease of access to a huge amount of information. [37]
- E-Learning helps in creating and communicating new training, policies, concepts, and ideas. Whether it is for formal education or entertainment, E-Learning is very quick way of learning! [19]
- It is flexible when issues of time and place are taken into consideration. Every student has the luxury of choosing the place and time that suits him/her.[37]
- E-Learning enables educators to get a higher degree of coverage to communicate the message in a consistent way for their target audience. This ensures that all learners receive the same type of training with this learning mode. [19]
- E-learning is cost effective in the sense that there is no need for the students or learners to travel. It is also cost effective in the sense that it offers opportunities for learning for maximum number of learners with no need for many buildings. [37]

## I.9 Disadvantages of E-Learning

- E-learning as a method of education makes the learners undergo contemplation, remoteness, as well as lack of interaction or relation. It therefore requires a very strong inspiration as well as skills with to the management of time in order to reduce such effects.[37]
- When it comes to improvement in communication skills of learners, e-learning as a method might have a negative effect. The learners; though might have an excellent knowledge in academics, they may not possess the needed skills to deliver their acquired knowledge to others.[37]

- E-learning may also deteriorate institutions' role socialization role and also the role of instructors as the directors of the process of education [37]
- Since tests for assessments in e-learning are possibly done with the use of proxy, it will be difficult, if not impossible to control or regulate bad activities like cheating.[37]

## I.10 Conclusion

The concept of E-learning is getting very popular these days, as many universities are offering degree and diploma programs through E-learning mode. [4]E-learning provides the students with the ability to fit learning around their lifestyles, effectively allowing even the busiest person to further a career and gain new qualifications. Some of the most important developments in education have happened since the launch of the internet. [3] Many big companies are investing in E-learning and setting up their interactive classrooms like Reliance and Tata. Also subject matter experts are developing new and versatile tools to create E-learning modules. [4]

# Chapter II

## MOOC

### II.1 Introduction

Massive open online courses (MOOCs) have attracted a great deal of interest in educational institutions. MOOCs anticipate leading the new revolution of technology-enhanced learning (TEL), by providing new opportunities to a massive number of learners to attend free online courses from anywhere all over the world. Over the last few years, the MOOCs phenomenon has become widely acknowledged as crucial for freely accessible high quality courses provided by international institutes for informal as well as formal education. [8] The growth in MOOCs is one example of how technology is transforming education and training delivery, and the MOOC model is gaining attention as a way to expand urgently needed access to higher education and workforce skills training in developing economies.

In light of that, this chapter will discuss the concept of MOOCs from general definitions, different between MOOCs and E-learning, MOOCs' pedagogy and its adaptation to learning and we will review some related works to get a wider idea of how MOOCs can be interpreted.

### II.2 Definition of MOOC

In its simplest form, A MOOC or Massively Open Online Course is a free online are courses designed for large numbers of participants that can be accessed by anyone anywhere as long as they have an internet connection, are open to everyone without entry qualifications, and offer a full/complete course experience online for free. [9]

MOOCs are a relatively recent evolution of online and distance-learning courses that are distinguished from more traditional online courses by having

no limit on attendance, open enrollment (no prerequisite courses or degree requirements), and no course participation fees. [10]

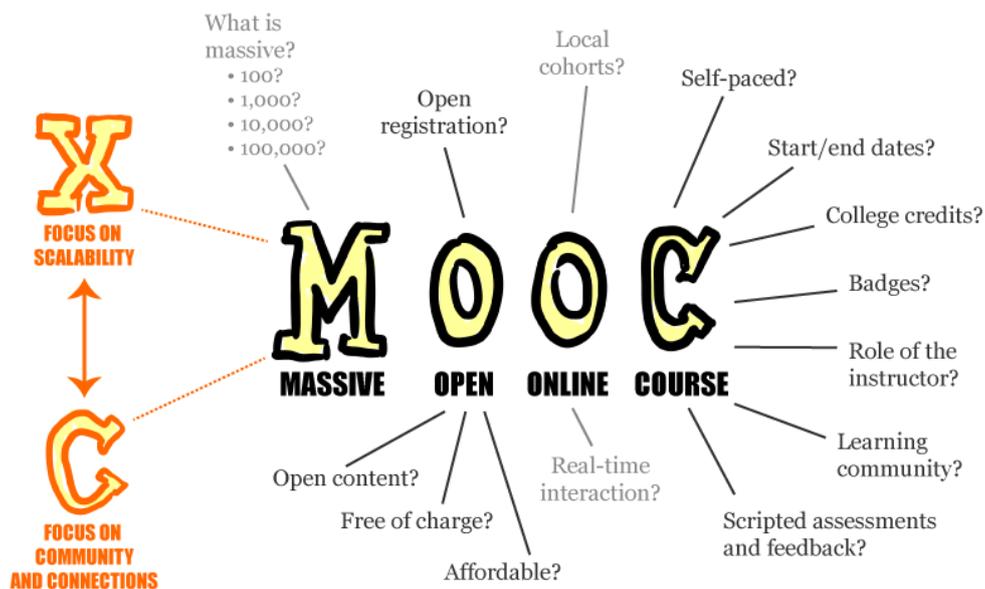


Figure II.1: MOOCs: Massive Open Online Course platforms

## II.2.1 MOOC Models

MOOCs can generally be categorised into two distinct types - **cMOOC** and **xMOOC**. **cMOOC** emphasises the development of understanding and knowledge through forum discussions and collaboration on joint projects, guided by connectivist theory. **xMOOC** resembles teacher-centric lectures, which are guided by behaviourist theory[12]. Since then XMOOCs period has started which included online courses that are structured in a more conventional way and delivered through not simple web platforms but some learning management platforms. **Coursera**, **EdX**, **Udacity**, **Udemy**, **Iversity**, **MiriadaX** and **Futurelearn** deliver some of the well-known MOOCs platforms around the US and Europe.

**cMOOCs:**(the connectivist MOOCs)are based on "connectivist distributed peer learning model. Courses are typically developed and led by academics through open source web platforms". **cMOOCs** refer to a type of MOOC that emphasizes student-centered, "connected" learning through social networking and knowledge co-creation.[11]

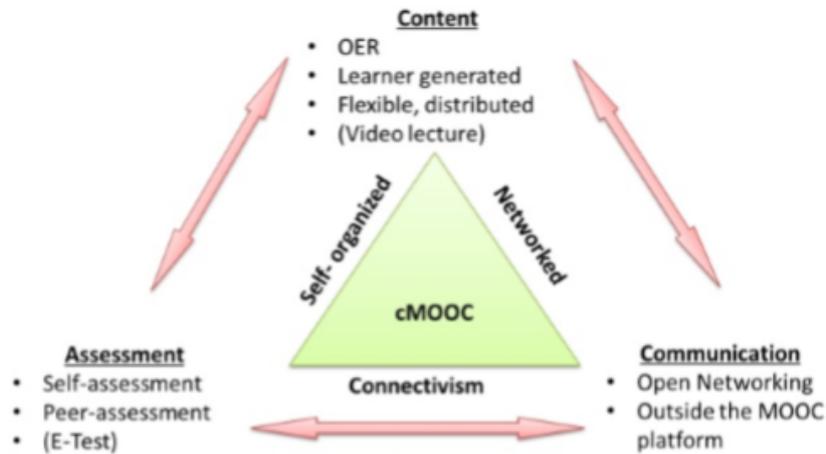


Figure II.2: Characteristics of cMOOCs

**xMOOCs:**(content-based MOOCs) are delivered through proprietary learning management platforms of institutions or individual academics. xMOOCs are instructor-centric courses that follow an instructivist learning model in which content is largely delivered through video lecture and reading materials, and feedback is given through computer-based quizzes and informal discussion groups. [11]

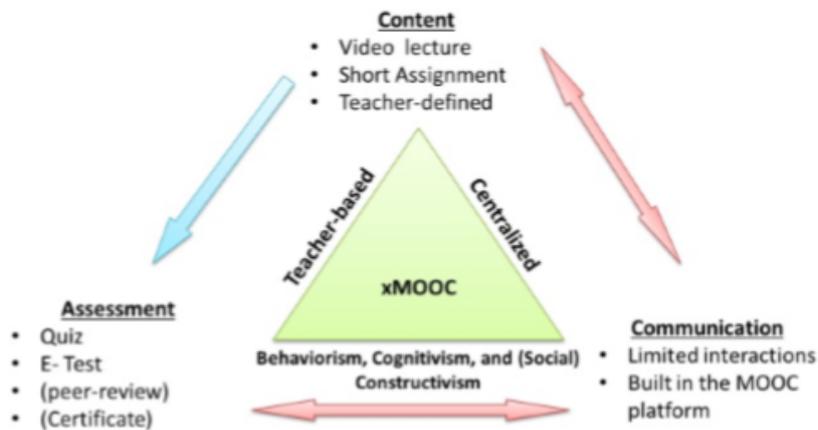


Figure II.3: Characteristics of xMOOCs

<b>xMOOCs</b>		<b>cMOOCs</b>
Scalability of provision	<b>Massive</b>	Community and connections
Open access - Restricted license	<b>Open</b>	Open access & licence
Individual learning in single platform	<b>Online</b>	Networked learning across multiple platforms and services
Acquire a curriculum of knowledge & skills	<b>Course</b>	Develop shared practices, knowledge and understanding

Figure II.4: Difference Between cMOOC and xMOOC

### II.3 Fundamental Characteristics of MOOCs

In one sense, a MOOC is just a course, it has facilitators, course material, a start and end date and has participants, But a MOOC is not a school, not just an Online course, it's a way to connect and collaborate while developing digital skills, it's a way of engaging in the learning process that engages what it mean to be a student It is (maybe most importantly) an event around the people who care about the same topic and get together and work and talk about it in a structured way.

The MOOC is:

- **Open:** Participation in a MOOC is free and open to anyone who has access to the Internet. One might take more than one course and all the content is open to course takers. all the work gets done in areas accessible for people to read and reflect and comment on[11], the course is open in a sense that you can go ahead and take the course without paying for it, you might pay to get the certified credit though an institution but you're not paying for participating in the course, it's also open in a sense that the work done in the course is shared between all the people taking it, the material put together by the facilitators, the work done by the participants it's all negotiated in the open, you get to keep your work and everybody get to learn from it.

- **Participatory:** The learning in a MOOC is enhanced by participation both in the creation and sharing of personal contributions and in the interactions with the contributions of others but the participation is voluntary. [11] You really become a part of the course by engaging with other people's work, participants aren't just asked to complete specific assignments but rather to engage with the material with each other with other material they may find on the web. You make connections between ideas, between you and other people, one of the outcomes that people get from the course are the network connections they built up from engaging with each other.
- **Distributed:** MOOC is based on the connectivist approach; therefore, any knowledge should be distributed across a network of participants. Most of the course activity takes place in social learning environments, where participants interact with the material (and each other's interpretations of it). [11]

## II.4 Difference Between E-Learning and MOOC

In one sense, you can argue that all MOOCs are e-learning but not all e-learning are a MOOC. Unlike an online course which focuses more on content, MOOCs focus more on context. Good content is a prerequisite to creating a MOOC but what keeps it going is dynamic building up of context around the content. Online courses are close-ended with static content. The content in a MOOC is not static. It evolves dynamically through learner participation, creation of user-generated content and collaboration. E-Learning courses are either bought off or custom built while MOOCs do not always require custom-built content to set up unless the need is very specific. Courses are close ended with a defined start and end point. Learning in a typical MOOC is not confined to a specific "digital space." It spills over with participants tweeting about their experience, blogging about it, holding meetups and Hangout sessions.

MOOCs enable building of PLNs (Personal Learning Networks). Participants in a MOOC typically come together from varied background; and without that particular MOOC, this diverse group of individuals may not have had any reason to come together. Online courses require basic computer skills of navigation. However, MOOCs can be effective in fostering some of the critical 21st Century skills like collaboration, self-driven learning, pattern sensing and problem solving. Participants in a MOOC "learn how to learn" in the course of a MOOC, with each one finding their own strengths and weaknesses.

MOOC	E-LEARNING
A MOOC can be taken by over 100,000 students simultaneously	Number of learners is usually restricted and not "open" to everyone.
Content is important but the dynamic context, such as blogs and forums around the content is fundamental	Focuses mainly on content
Dynamically evolves through learners' participation and collaboration. Each MOOC gather around blogs, podcasts, social media posts, videos, enhancing original content of the course	Close-ended with static content
Learners come voluntarily, courses are built on the principle of just-in-time. Putting learners in charge of their own learning ( <b>Pull Model</b> )	Courses are assigned to learners, they do not cater for just-in-time. Learners are not voluntarily signing-up ( <b>Push Model</b> )
Learners from a group or cohort, learn together and collaborate to enrich the content	Learners learn in isolation, as individuals
MOOCs are based on the principle of Micro-Learning with learning bites no longer than 10 minutes. Content can be repla	Courses are either bought off-the shelf or custom built with less flexibility to update

Table II.1: Difference between E-Learning and MOOC

## II.5 MOOC's Pedagogy

Basically, MOOCs courses based on three areas of student engagement:

- **Video Lectures:** Video lectures in MOOCs have various presentation styles, from talking heads to lecturing instructors. The running time for the lecture videos is usually 5-10 minutes each with in video quizzes embedded. [11]
- **Assessment:** Assignments are primarily evaluated through the use of: (a) auto-graded multiple choice questions or auto-graded programming assignments, (b) peer review assessment where students themselves evaluate and grade assignments based on a defined rubric set[11].
- **Forums:** Forums are where students post questions and other students

replies, and are the main method of student interaction between course takers and instructors. Forums usually consist of general discussion, subject-specific discussion, course feedback, and technical feedback threads. [11]

- Readings: Most MOOCs do not require students to buy books, and most readings are available online or provided by course instructors. [11]
- Live video sessions: In addition to the weekly lectures, there are live video sessions with the course instructor. [11]
- Social Media: Students are encouraged to continue their discussions on dedicated pages on other social media platforms, such as **Facebook** and **Google+**. [11]

## II.6 Adaptation of Learning Styles

Instruments of learning style are built on the premise that there is no one teaching style or curriculum that fits all learners because they have different preferences, needs and abilities. [38] Over the last decades, Massive open online courses (MOOCs) have become a more extended curiosity for learners, providers, university, and researchers. Free online courses have been accessible since the mid-2000s. The MOOC methodology is generally known in that it can achieve a wide group of learners. [13] There is no doubt that learners and teachers are different in various ways. Gaining knowledge on students' learning styles can be very helpful for both teachers and learners. Involving learners in the active process of learning requires identifying and understanding learners learning styles and teachers teaching styles. [14] Teaching and learning are the main components of the system of education. This system formally runs in school. The students learning takes place in classroom environment. So if the classroom environment is effective the system of education is successful. [15]

### II.6.1 Definition of Learning Styles

Learning style are defined as “the complex manner in which, and conditions under which, learners most effectively perceive, process, store, and recall what they are attempting to learn”. [14] Learning styles are authentic as the appropriate techniques or methods in which learners learn, comprehend and get information. A few analysts characterized a learning style as a

methodology of taking in a thought. This is because each learner has an alternate favored way to deal with comprehension or learning things. For instance, some learners adapt to and accomplish bigger if acquirement's visually, while others may adapt to apprentice aurally. [13]

## II.6.2 Learning Style Models

Learning style is a component of the wider concept of personality. McAdams and Pals offer a five-principle model of the whole person that encompasses evolutionary design for human nature, dispositional traits, characteristic adaptations, self-defining life narratives, and culture/social contexts. [16] Learning styles play a significant role in the lives of learners. When students recognize their own learning style, they will be able to integrate it into their learning process. As a result, learning process will be easier, faster, and more successful. Another benefit of identifying learners' style is that it assists them in solving problems more effectively. [14]

There are different models which depicts that there are different learning styles and each learner had been preferred learning styles. That helps the learner in learning situations.

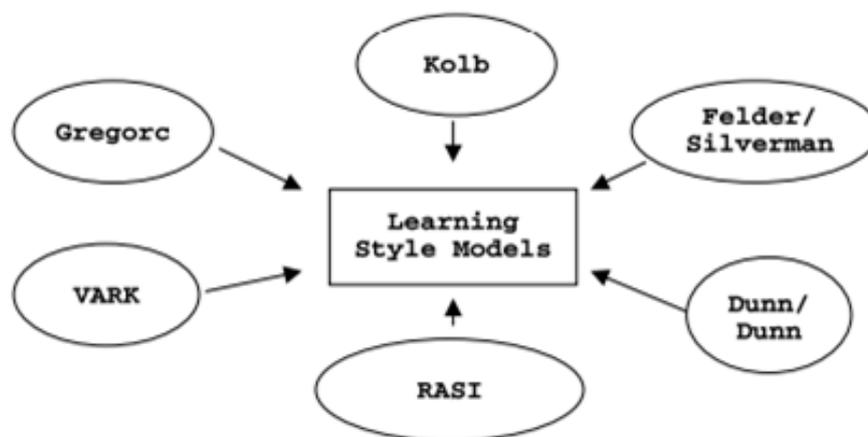


Figure II.5: Different Learning Style Models

### I. KOLB'S LEARNING STYLE MODEL:

The Kolb Experiential Learning Theory addresses experience as a source of learning and development. This theory considers learning as creating new knowledge through the transformation of experience and defines the learning style as “generalized differences in learning orientation based on the degree to which people emphasize the four modes of the learning process”. [38] Kolb developed his learning style model over years basing it on the research on various others, for example Rogers, Jung, and Piaget. Kolb's learning theory includes four different learning styles, which are based on a four-stage learning cycle. [15]

The learning cycle stages are:

- Concrete Experience (CE) – feeling
- Reflective Observation (RO) - watching
- Abstract Conceptualization (AC) - thinking
- Active Experimentation (AE) - doing

Kolb said that concrete experiences lead to observations and reflections. These reflections are immersed and translated into abstract concepts with implications for action, which a person can actively test and experiment. This enables creation of new experiences and starts a new cycle. [15]

The four basic learning styles developed by Kolb are:

- **Diverging** (combination of Concrete Experience (CE) and Reflective Observation (RO)): learners with this preference seem to be more imaginative, emotional and they prefer to work in groups. [38] This learning style emphasizes concrete experience (“feeling”) and reflective observation (“watching”). [13]
- **Assimilating**(combination of Abstract Conceptualization (AC) and Reflective Observation (RO)): They have the ability to deal with a wide range of information, rearrange it logically and they seem to be more inductive.[38] This person's dominant learning abilities are abstract conceptualization (“thinking”) and reflective observation (“watching”). [13]
- **Converging**(combination of Abstract Conceptualization (AC) and Active Experimentation (AE)): The convergent learning style relies on abstract conceptualization (“thinking”) and active experimentation (“doing”), [13] convergers' learning preference is more active, they get more from technical and practical tasks [38].

- **Accommodating**(combination of Concrete Experience (CE) and Active Experimentation (AE)): The fourth learning style emphasizes concrete experience ("feeling") and active experimentation ("doing"). [13] Learners with this style usually depend on others to get information and tend to adopt an intuitive approach to solving problems rather than logical analysis [38].

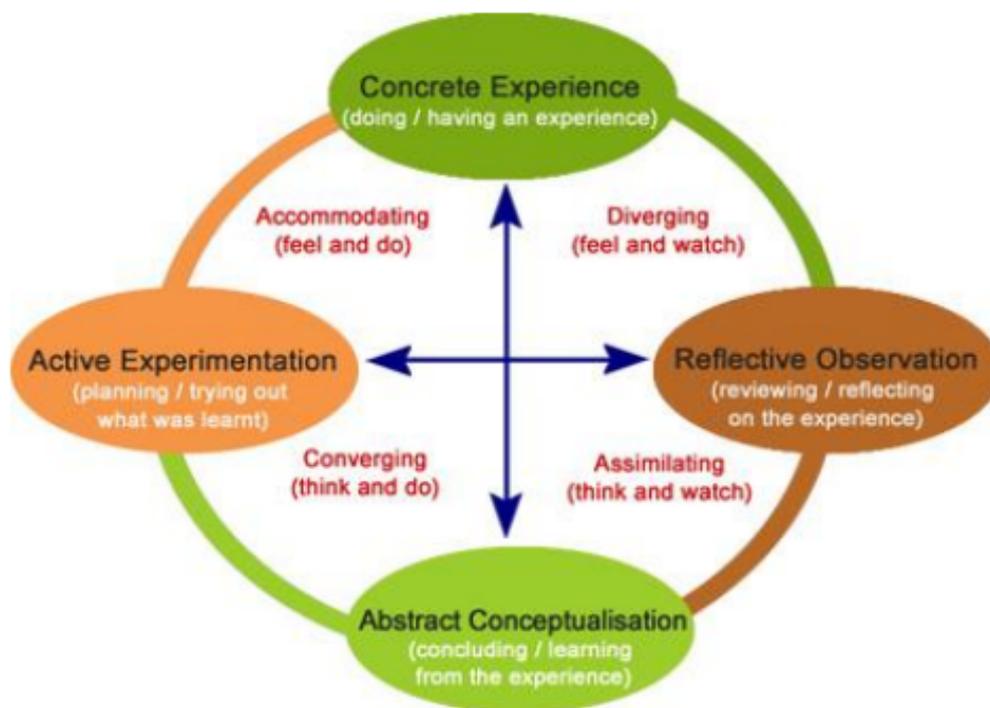


Figure II.6: The Kolb's Learning Style Model

## II. DUNN AND DUNN MODEL:

Dunn and Dunn Learning Styles Model is one of the famous models within learning style models. [15] This model defines learning style as "the way in which individuals begin to concentrate on, process, internalize, retain new and difficult information". [38] It represents that both biological and individual developmental qualities possessed by an individual and how a person learns new information and skills are indicated by this peculiar characteristic of that person. [15]

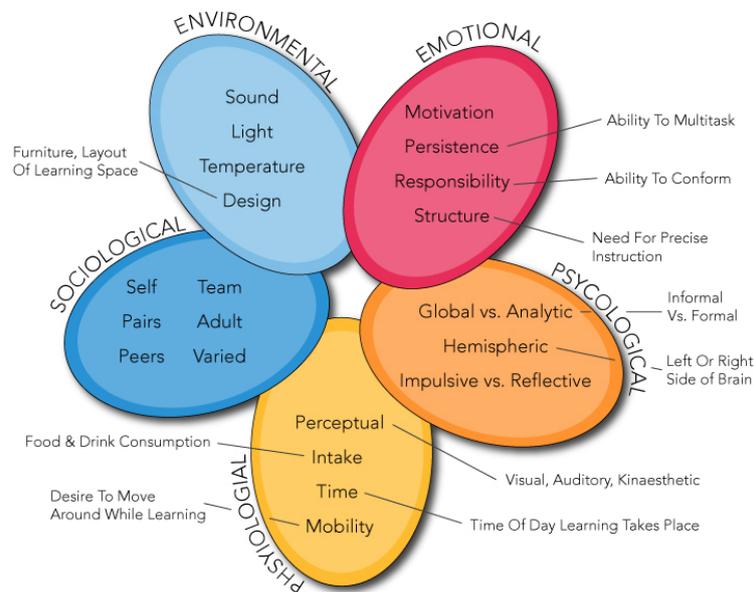


Figure II.7: The DUNN and DUNN's Learning Style Model

Dunn and Dunn claim that the learning style contains five dimensions:

- Environmental dimension: it includes elements such as sound, light, temperature, and design (e.g., "Sound or external noise may positively or negatively influence learning style"). [13]
- Emotional dimension: Motivation, persistence, responsibility, and structure (e.g., "Motivated, persistent, responsible students usually require little structure and supervision"). [13]
- Sociological dimension: People can learn in a variety of sociological patterns that include working alone, with one or two friends, in a small group, or as a part of a team. [13]
- Physiological dimension: People learn through different senses such as auditory, visual or tactile senses or a combination of senses. [13]
- Psychological dimension.

### III. THE VARK MODEL:

The third model is the VARK model created by Neil Fleming which is a sensory model that is an extension of the earlier neuro-linguistic model. [16] Fleming introduces the learning style as "an individual's characteristics

and preferred ways of gathering, organizing, and thinking about information”.[38]The acronym VARK stands for Visual (V), Aural (A), Read/Write (R), and Kinesthetic (K).[16]

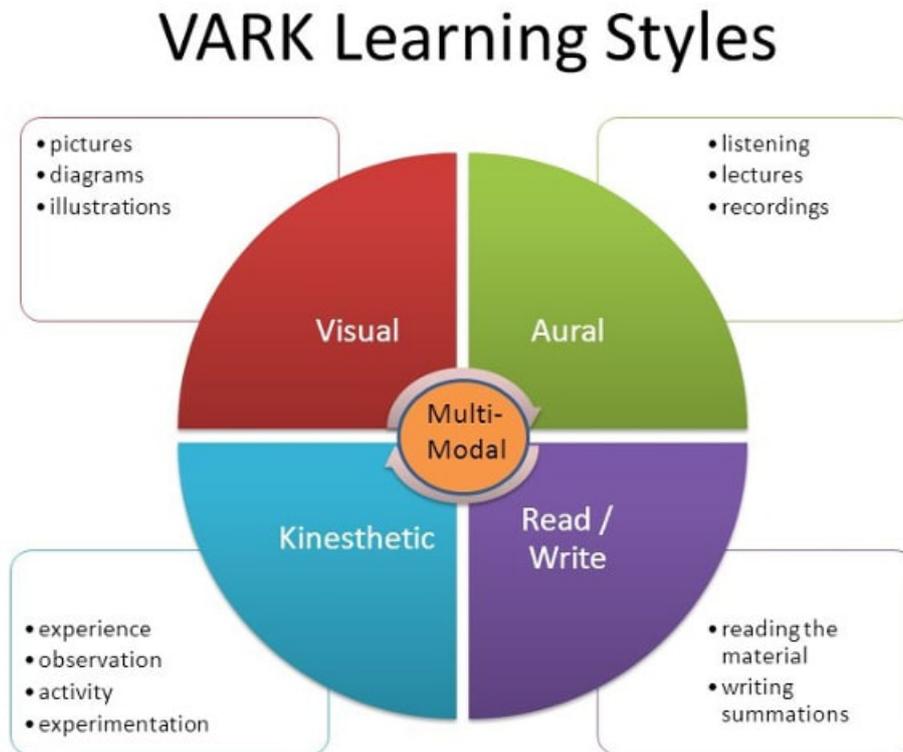


Figure II.8: The VARK Learning Style Model

The VARK has four sensory modalities:

- **Visual Learning:** visual students respond strongly to visual resources, including charts, pictures, diagrams, maps, flow charts and highlighted text. They also prefer to draw maps or charts to deliver information to others [38].
- **Auditory Learning:** Aural learners like to explain new ideas to others, discuss topics with other students and their teachers, use a tape recorder, attend lectures and discussion groups, and use stories and jokes.[16] They also prefer to talk to others and discuss with them to explain facts.[38]
- **Read/Write Learning:** These learners seem to be more comfortable with written resources (lists, essays, reports, textbooks, definitions, printed handouts, readings, manuals, Web pages). [38]

- Kinesthetic Learning: Kinesthetic learners like field trips, trial and error, doing things to understand them, laboratories, recipes and solutions to problems, hands-on approaches, using their senses, and collections of samples [16]. Kinesthetic students tend to use practical resources such as exercises and case studies. They also prefer doing things to get information about it.[38]

The VARK Inventory provides metrics in each of the four perceptual modes, with individuals having preferences for anywhere from one to all four. Individual students have relative preferences along each of the four perceptual modes but can learn to function in the other modes. Fleming reports that about 41% of the populations who have taken the instrument online have single style preferences, 27% two preferences, 9% three, and 21% have a preference for all four styles. [16]

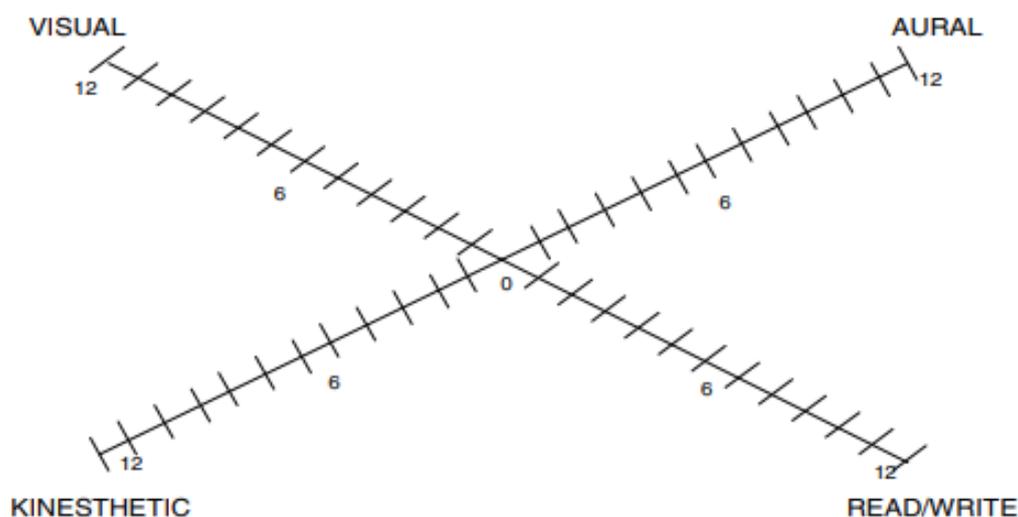


Figure II.9: The VARK Learning Style Model Inventory Metric

#### IV. FELDER AND SILVERMAN'S LEARNING STYLES MODEL (FSLSM):

The fourth model is the Felder–Silverman Learning/Teaching Style Model. This model, originating in the engineering sciences, defines learning style as “the characteristic strengths and preferences in the ways individuals take in and process information” [16] A standout amongst the most broadly utilized models of learning styles. As per this model there are four dimensions of learning styles. [13] It also proposes classifying teaching methods according to learning style poles by providing a parallel teaching style [38].

FSLSM asserts that individuals have preferences along four bipolar dimensions:

- Active / Reflective
- Sensing / Intuitive
- Visual / Verbal
- Sequential / Global

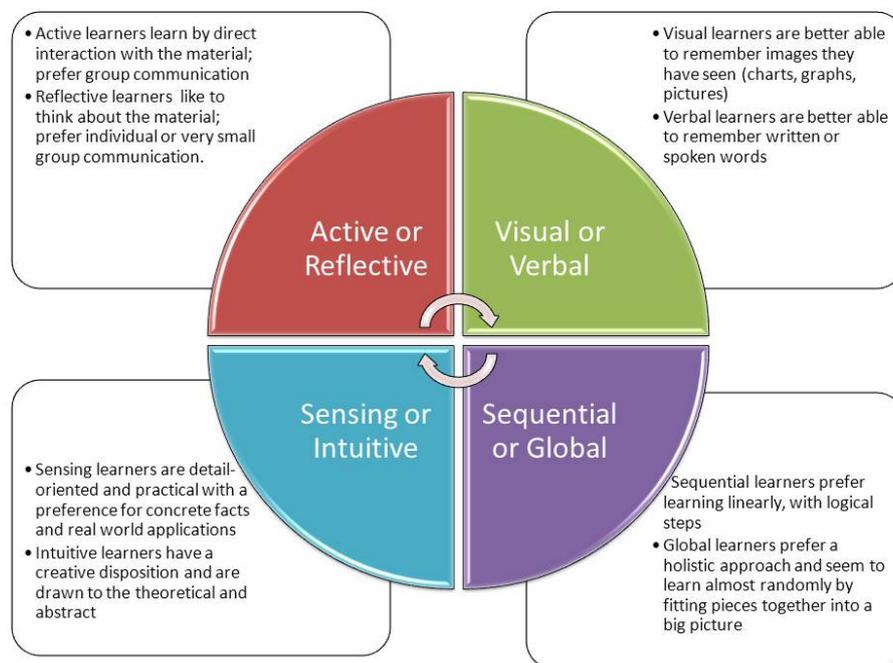


Figure II.10: The FELDER AND SILVERMAN's Learning Style Model

- Active: Active learners learn by doing something with information. They prefer to process information by talking about it and trying it out. [13]
- Reflective: Reflective learners learn by thinking about information. They prefer to think things through and understand things before acting. [13]
- Sensing learners prefer to take in information that is concrete and practical. [13] They get more from facts and experimentation and they are more comfortable with detailed data. [38]

- Intuitive learners: they respond strongly to theories, symbols, less detailed data and they are less patient with timed tests. [38] They like discovering possibilities and relationships and working with ideas. [13]
- Visual learners prefer sight in receiving new information. Therefore, they get more from pictures, figures, charts... etc. [38]
- Verbal learners prefer explanations with words – both written and spoken. [13] Therefore, they get more from the discussion, records, chatting and reading [38].
- Sequential learners prefer to organize information in a linear, orderly fashion. They learn in logically sequenced steps and work with information in an organized and systematic way.[13] they also prefer tackling the complexity in a steady progress [38]
- Global learners prefer to organize information more holistically and in a seemingly random manner without seeing connections. [13] They usually do not depend on the clear sequence in progressing because they are able to link and integrate the ideas to form overall concepts.

The Index of Learning Styles (ILS) provides metrics for all but the Intuitive-Deductive dimension, with scores showing the strength of an individual's preference for the indicated continuum. Individual students have relative preferences along each of the four but can learn to function in the other direction. [16]

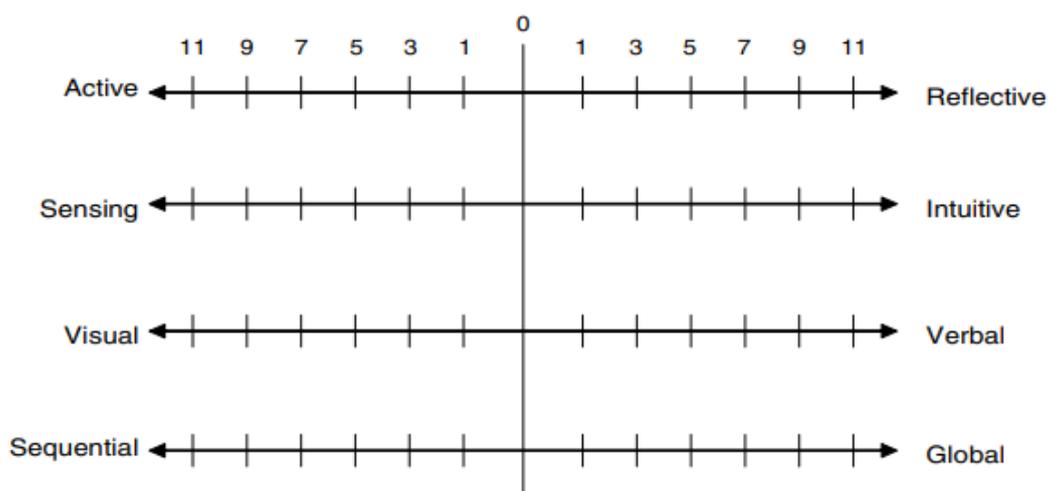


Figure II.11: The Index of Learning Style (ILS) metric

The ILS is a questionnaire contains 44 questions covering the four basic dimensions of the model. Each of the 11 questions, provide metrics for only one dimension and participants choose only one answer for each question. [38]

### II.6.3 Adaptation Of Learning

Adaptive learning systems are designed to align learning sequences and learner profiles. They use, for this purpose, one or more models to represent knowledge. In this context, the techniques of artificial intelligence are used for modeling of learners and the adaptation of teaching sequences. The objective is to provide the learner, at any time, relevant information presented in an appropriate manner [17]. Understanding learning style helps learners in learning how to learn. Thereby, learners become more autonomous and accountable for their own learning. Consequently, learners' confidence will increase and teachers control over learners will lessen. At this point, learners become the center of the learning process and control their learning while teachers act as facilitators. [14]

## II.7 MOOCs During The Pandemic

COVID-19 has affected the student's education as they need to stay at home during the lockdown. To ensure continuous learning, teaching and learning activities were delivered through online learning. Since then, there are high demand and usage of the Massive Open Online Course (MOOC) platform.



Figure II.12: The Increase Use of MOOC Platforms During The Pandemic

The top three MOOC providers (Coursera, edX, and FutureLearn) registered as many new users in April as in the whole of 2019[22]. As millions suddenly found themselves with free time on their hands during the pandemic, many turned to online courses.

### The Second Year of the MOOC

	2012	2020
Funding	\$100 million	\$900 million
Learners	\$2 million	\$180 million
University partners	40	950
Courses	250	16,300
Revenue	0	Hundreds of millions

Source: Class Central • Created with Datawrapper

Figure II.13: The Increase Funding for MOOC Platforms During The Pandemic

Coursera has already capitalized on these circumstances: it doubled its valuation and is considering going public in 2021. As a result, MOOCs during the pandemic reached a broader population with wider interests.

New Registered Users	2019	2020	Total
	8M	20M	65M
	5M	8M	32M
	1.3M	4M	13.5M
	350k	700k	2.2M

Figure II.14: The Increase Registered Users for MOOC Platforms During The Pandemic

### II.7.1 Awareness of MOOCs

A survey has been ran over 161 people asking them whether they've heard of MOOCs or what even is a MOOC and the majority of the respondents (73.9 %) were not aware of MOOCs and only (26.1 %) of the respondents were aware of MOOCs.[21]

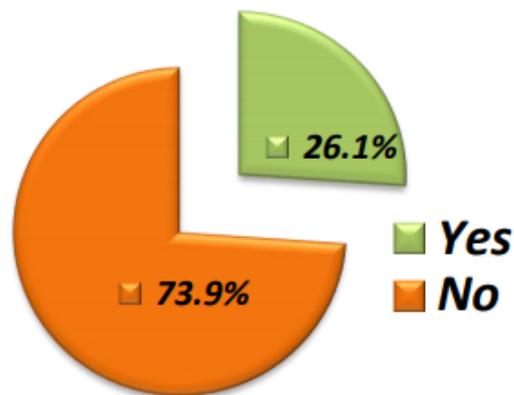


Figure II.15: The public awareness of MOOCs

### II.7.2 Interests in MOOCs

Another survey was ran on the respondents whom have heard of MOOCs and been asked if they were interested in taking an online open course and the majority said Yes with (69%) while the remaining (31 %) was still hesitant because they still prefer the Face To Face form of studying.[21]

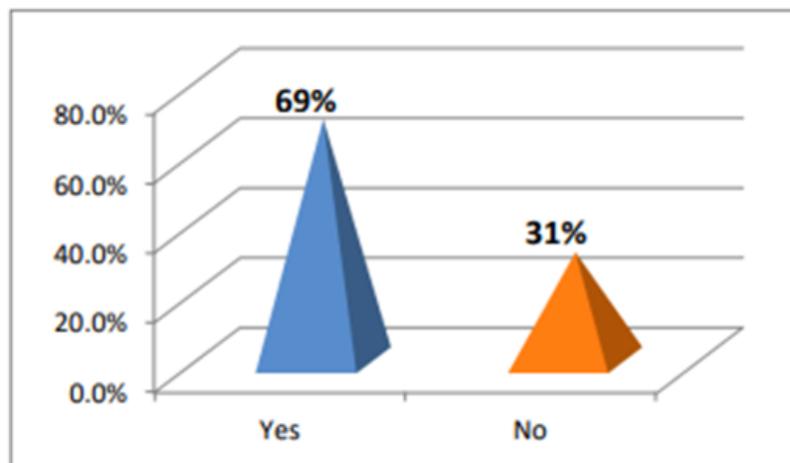


Figure II.16: The public interest in MOOCs

### **II.7.3 Challenges associated with Online Learning:**

Even though online learning is not a novel phenomenon, this sudden transformation into online learning has posed substantial challenges for educational activities globally, and particularly in resource-scarce environments such as Algeria, where educational institutions, teachers, and students are generally not ready for this unexpected disruption to traditional teaching and learning methods.

With online learning as the replacement of physical classrooms amid the COVID19 crisis, many students are vulnerable to falling behind in their studies or experience additional challenges due to their socioeconomic status, their lack of responsibility and not taking online learning seriously [23]. Students from low socio-economic families are not able to afford broadband connection and pertinent devices such as computers/laptops or tablets to support their online learning. Instead, they are using smartphones to access lessons and learning materials, complete assignments, and take exams.

### **II.7.4 Suggestions to ensure the Effectiveness of Online Learning:**

Despite the challenges that COVID-19 have presented to online learning, it has paved the way for the digital transformation of education and enhanced the adoption of Information and Communication Technology (ICT) in the classroom. In developing countries like Algeria, COVID-19 provided concerned education stakeholders with the opportunity to explore the pros and cons of online learning, potentially paving the way for greater adoption of ICT and blended learning in the post-COVID-19 time.

## II.8 Related Works

### II.8.1 [17] 1st Related Work

#### Overview

This work is interested in contributing on multi-agents systems and ontologies to describe the learning preferences and adapt educational resources to learner profile in MOOCs platforms. The primary aim of this work is to exploit the potential of multi-agents systems and ontologies to improve learners' engagement and motivation in MOOCs platforms and therefore reduce the drop-out rates.

#### MBTI Tool for Describing Learning Preferences

The MBTI (Myers Briggs Type Indicator) is a model of psychological assessment determining the psychological type of a subject, following a method proposed in 1962 by Isabel Briggs Myers and Katherine Cook Briggs. It serves as a tool in the identification of psychological dominant of persons in contexts related to management or to the problems in the context of interpersonal relationships. This model is based on the theory of psychological types of MBTI and directly inspired the theory of psychological types of Carl Gustav Jung.

#### An Ontologies base Multi-Agents System

In the proposed model, the process of profiling is based on the theory of psychological types of MBTI. The multi-agents system includes two main agents (Profile Management Agent and Resources Builder Agent) revolve around four main ontologies (Learner ontology, Resource ontology, Domain ontology and Pedagogical Strategies ontology), they even composed of a set of sub-ontologies. To lead learners to the completion of courses where they are enrolled, these agents are used to select the appropriate content and adopt a suitable strategy of teaching/learning.

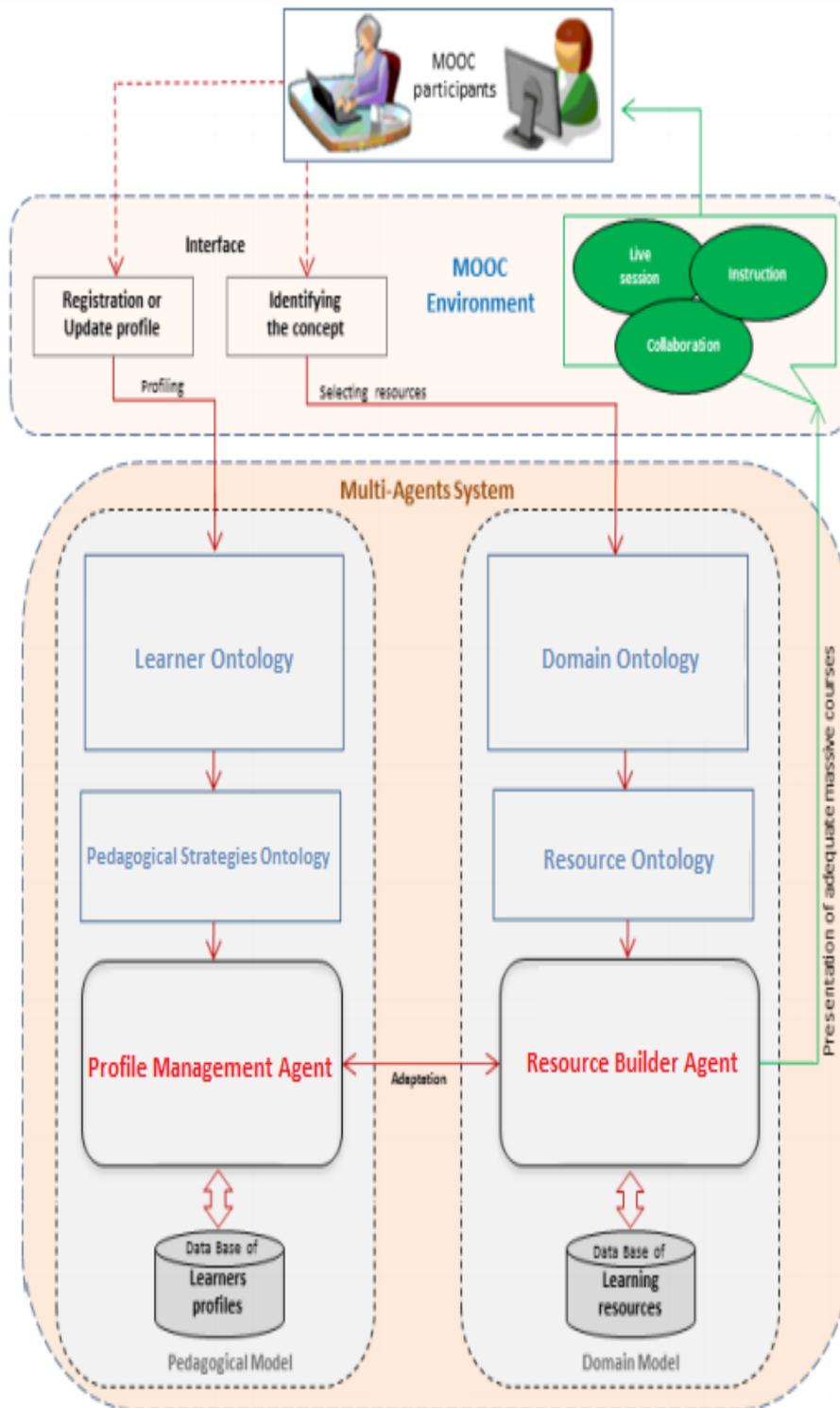


Figure II.17: The architecture of the proposed system

## II.8.2 [18] 2nd Related Work

### Overview

A hybrid Neural Network (NN) model is proposed in this project which integrates a Convolutional Neural Networks (CNN) and with a Gated Recurrent Unit (GRU) based Recurrent Neural Networks (RNN) in an effort to detect individual learning style dynamically. The model was trained by learners' behavior data and applied to predicting their learning styles. With identified learning style for each learner, the power of MOOC platform can be greatly enhanced by being able to offer the capabilities of recommending specific learning path and the relevant contents individually according to their characters.

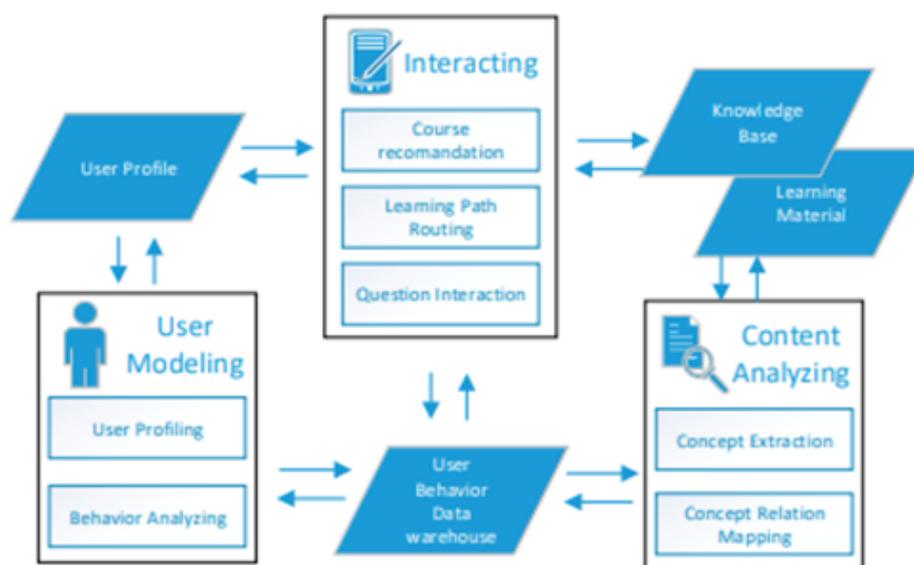


Figure II.18: The architecture of the proposed system

### Using Felder-Silverman's Learning Style Model

Various learning style models were proposed in the last 50 years, with concerns on different aspects, such as student characters, emotional situations, cognitive styles, and even environments. Among these studies, Felder-Silverman Learning Style Model (FSLSM) is the one that has been widely adopted. FSLSM considers learning styles as “flexible stable”, arguing that the learning styles of students come from their previous learning experiences together with other environmental factors.

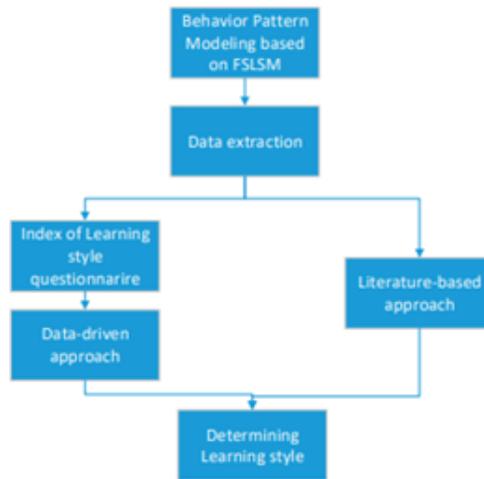


Figure II.19: The process of the FLSM in the proposed system

According to FLSM, learners can be categorized using Active/Reflective, Sensing/Intuitive, Visual/Verbal, Sequential/Global dimensions, ranked in different levels, and the adaptive learning system then provides appropriate contents and learning path correspondingly. For example, the system will provide Reflective users the method based on Problem-Based Learning Approach which employs a series of questions to lead the students finding the solution to the problems. And for the Active users who tend to get information aggressively, it will continuously push the latest ideas on Course Interactive Forum to them so as to inspire a more in-depth and efficient study.

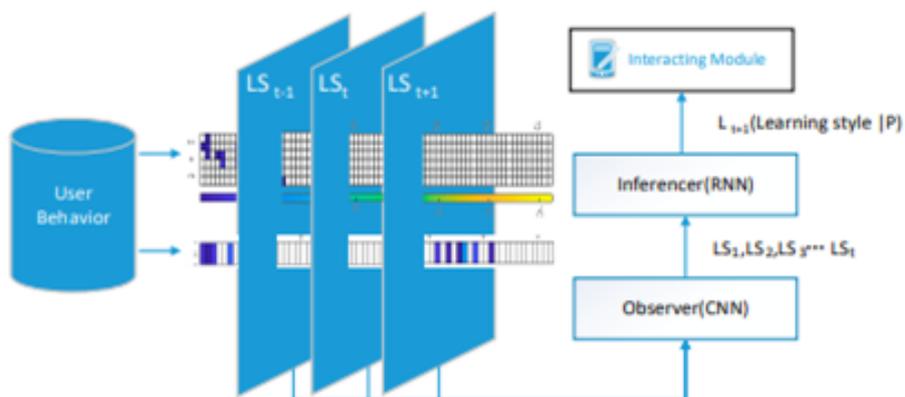


Figure II.20: Integrating the Convolutional Neural Network CNN

A convolutional neural network was designed to observe and identify the state of user behavior, and then connected with a modified GRU-based recurrent neural network to predict the learning style of next state. The testing process showed that the trained model in this paper can identify the learning styles of users efficiently and effectively, and could be further extended for the intelligent analysis of an AI enforced adaptive learning management system. This is valuable for the next considerations.

### II.8.3 [20] 3rd Related Work

#### Overview

This study employed systematic literature review (SLR) method to summarize and review available functionalities as the core in designing a proposed MOOC architecture model. The proposed model covers application layers (user, system, and data layers) and adopts the theories of cognitive, constructive, and social situated learning.

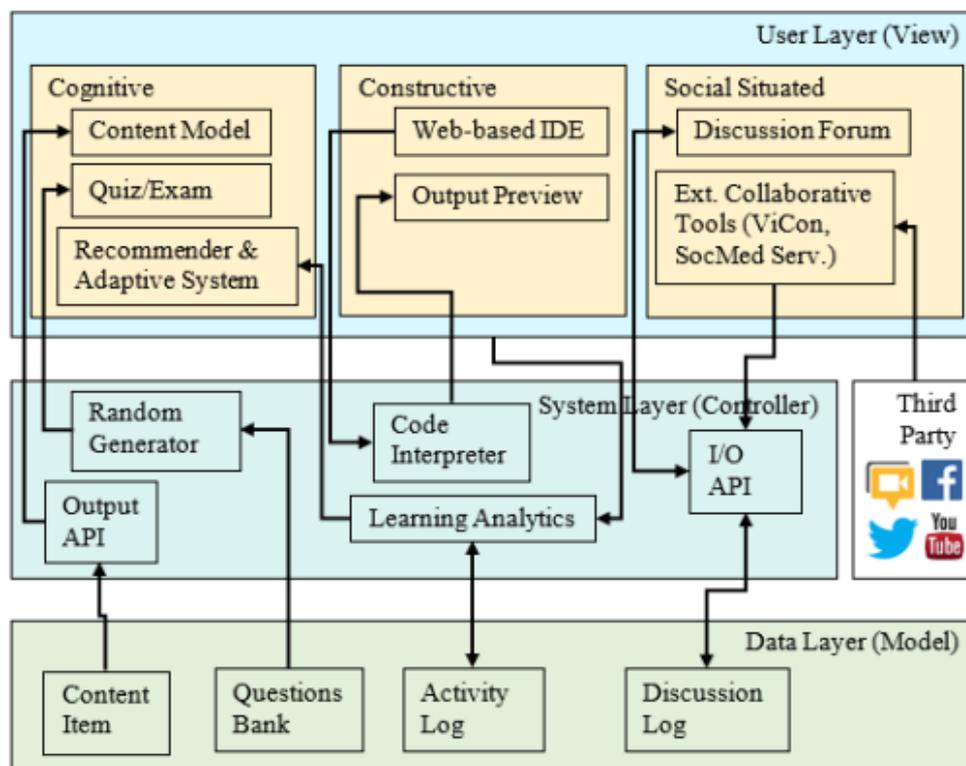


Figure II.21: The general architecture of the proposed system

The proposed model is separated in 3 layers:

**First**, User Layer is front-end (view) section that interacts with learner. This layer consists of features that are mapped into 3 learning theories (Content model, quiz/exam, and recommender adaptive system) these theories are proposed to improve learner's understanding of programming.

**The second layer** is system layer that control the logic between data layer and user layer. This layer consists of set of algorithms to randomize questions, stream the materials, analyze the activity log recorded, interpret code written by learner into output preview, and store any communication log.

**The third layer** is data layer that physically represent material files, questions bank, database, and log files. These 3 layers actually represent Model-View-Controller (MVC) framework in software engineering.

The proposed model is capable of providing a virtual learning environment unbounded by the limitations of time, places, and device compatibility and performance. The proposed model would significantly improve students' access to write and compile code across platforms and (even in mobile) devices. Since this study has been based on SLR, it is highly suggested that further development of the model should include empirical data obtained from controlled experiments. This way, constructs such as score, motivation and passing rate could be examined and further used to better the model.

### II.8.4 Comparison Between The Related Works

Project	Theory	Objective	Outcome	Proposed Function
[17]	MBTI	Creating a MOOC that motivates the learner based on their ontologies	Using agents (Profile Management Agent, Resource Builder Agent) to lead the learner to the course's completion	Multi-Agent System
[18]	Felder-Silverman Learning Style Model	Identifying the Learning Style based on the learner's behavior	Enhance the MOOC's efficiency based on the collected data	Intelligent mechanism based on Hybrid Neural Network which integrates Convolutional Neural Network
[20]	The cognitive, constructive, social situated theories	Creating a platform that helps learners with their programming courses	Improve the learner's access to write and compile across platforms	The Systematic Literature Review (SLR) methods

Table II.2: Comparison Between The Related Works

## II.9 Conclusion

Massive open online courses (MOOCs) are one of the most prominent trends in higher education in recent years. It represents open access, global, free, video-based instructional content, problem sets and forums released through an online platform to high volume of participants aiming to take a course or to be educated.[11] MOOCs present an emerging branch of online learning that is gaining interest in the technology enhanced learning (TEL) community [8], MOOCs are a new learning environment that aims at breaking down obstacles to learning for anyone, anywhere and at any time around the globe is far away from the reality. In fact, most MOOC implementations so far still follow a top-down, controlled, teacher-centered, and centralized learning model. Attempts to implement bottom-up, student-centered, really open, and distributed forms.

The popularity of MOOCs has drawn attention from institutions, governments and private investors around the globe trying to build their brands and to enter the education and training market. [12]

# Chapter III

## CONCEPTION

### III.1 Introduction

Due to the COVID-19 situation, educational institutions have been forced to switch to online mode by suspending the traditional classroom and have switched to the online mode. These online platforms provide certificates as a token of achievement, which adds value to their profile, as it is endorsed by reputed partner universities. In the COVID-19 health crisis, the majority of the students have experienced online learning. Educational institutions have not been flexible enough to understand the demographic background of the vast student community. Not every student is bestowed with technology and internet connection to take uninterrupted learning especially in growing countries, that's when MOOCs and many EdTech platforms come in to play a huge part of motivating the student to learn by creating a well-fitting environment and offering an array of courses to cater to different needs of people across the world.

The purpose of this work is to develop a MOOC web application that offers personalized learning using learning style instruments. The personalized learning process is to change the behavior and characteristics of the system according to the user who interacts with it to deliver the appropriate materials using the pertinent learning styles for each learner. The system must provide the appropriate information for each user taking into account their learning style. Our work is based on two models, The VARK model created by Neil Fleming, the FSLSM by Felder- Silverman and the Kolb model by David Kolb, by combining these models, we will use their instruments to measure the learning style of the learner. But first, we need to justify our choice of relying of these models. Then, we will present the architecture of our proposed system to give a general idea of the strategy and the adaptation

rules followed for each learning style of these models.

## III.2 The Chosen Learning Styles

We've already covered the classification of learning styles models in the second chapter. Each model differs according to the learning theory taken in consideration. We chose the VARK model by Fleming to figure out the learner's preference on how to receive new information; we took two learning style instruments from this model (Visual, Aural). It is easy to set the preference of the learner by setting up a Questionnaire. The VARK model retains great simplicity to be implemented; it is desirable for the educational hypermedia use.

For information processing, we chose the Active-Reflective style of the FSLSM by Felder-Silverman. This model has been famously used for several studies involving Science. It is suggested as the more suitable for adaptive E-Learning systems to provide adaptation based on learning styles.

The Kolb Experiential Learning Theory addresses the developed learning habits that help the learner to benefit more from some experiences than from others. The learners may be unaware of this, but we'll have a questionnaire that will help them pinpoint their preferences and share them with the other facilitators.

In our system we aim to use a combination of the VARK, the FSLSM and the Kolb learning models, depending on the learner's preference whether he would like to take courses that rely on visual devices (photos, graphs, etc...) and if they like to work with others (Visual-Active) or they like to work alone (Visual-Passive). In the case of the learner is more of an aural learner, we would integrate more audio material, whether they liked having discussions and being involved in group chats (Aural-Active) or they were more of a learner by examples and summary videos (Aural-Passive).

In case the first questionnaires failed to distinguish the learner's preference, the Kolb Questionnaire might help to pinpoint their drives based on their previous experiences to classify whether they're ACTIVISTS (learn better from activities and new experiences), THEORISTS (prefer handouts, something to take away and study), REFLECTORS (like to read and discuss) or PRAGMATISTS (like to have some shortcuts and tips).

## III.3 The System Architectures

### III.3.1 The General Architecture

We've proposed an architecture that gives a general idea of how the system works based on four models, each one is divided into a set of modules that help implementing the personalized learning process:

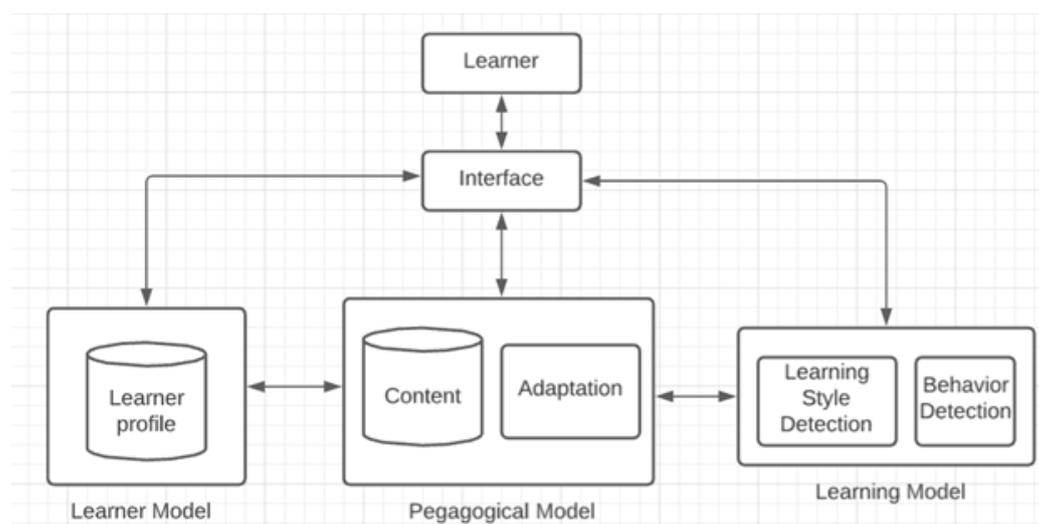


Figure III.1: The general architecture of our system

#### Interface

A well-adjusted, well-informed interface would draw the learner into the MOOC; it is a component that ensures the communication between the learner and the system.

#### Learner Model

The learner model contains information about the learner and their preferred process of learning; it also contains a profile which includes their personal information such as: Name, Username, Email, Password, etc. . .

#### Learning Model

This model is composed by two modules:

**Learning Style Detection Model** This model presents two questionnaires to detect the learner's preference of learning:

- The VARK Questionnaire:

VARK Questionnaire consists of 16 questions to pinpoint the preference of the learner and helps your learning by suggesting the strategies that the learner should be using:

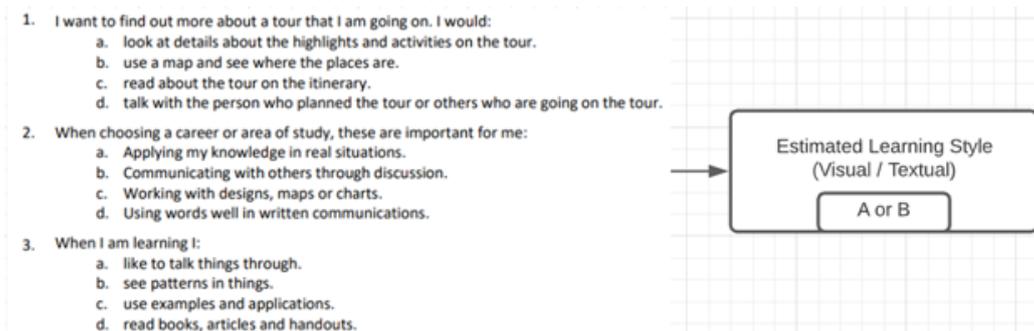


Figure III.2: The VARK Questionnaire

- The Index Learning Style Questionnaire:

The ILS Questionnaire consists of 44 questions based on the FSLSM methods:

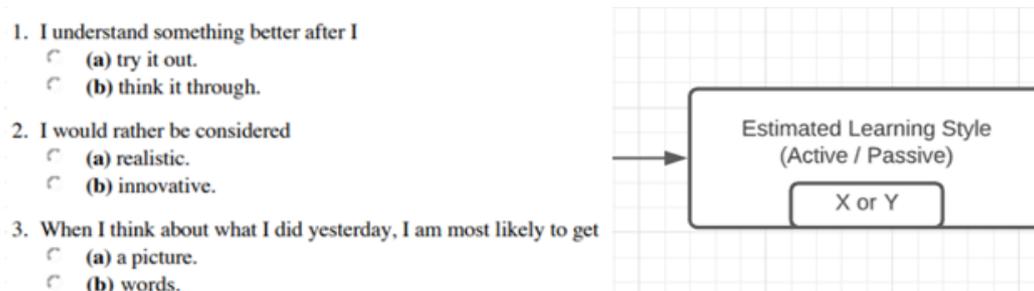


Figure III.3: The ILS Questionnaire

This model is used to identify and determine the learning style of the learner based on combining the answers received from the VARK and the ILS questionnaires.

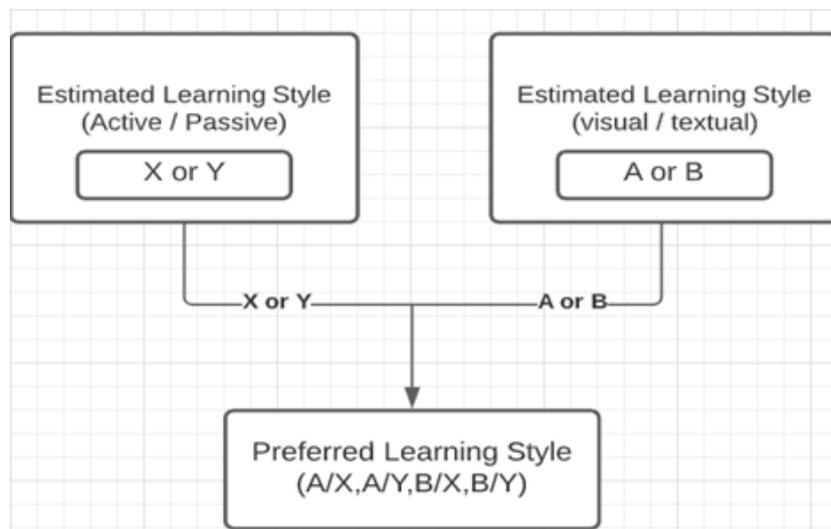


Figure III.4: The Process of Learning Style Detection

**Behavior Detection Model:**

This model consists of a questionnaire based on the Kolb’s Learning Style Model methods, This questionnaire is designed to find out the learner’s preferred learning styles(s). It consists of 80 questions and the accuracy of the results depends on how honest the learner is:

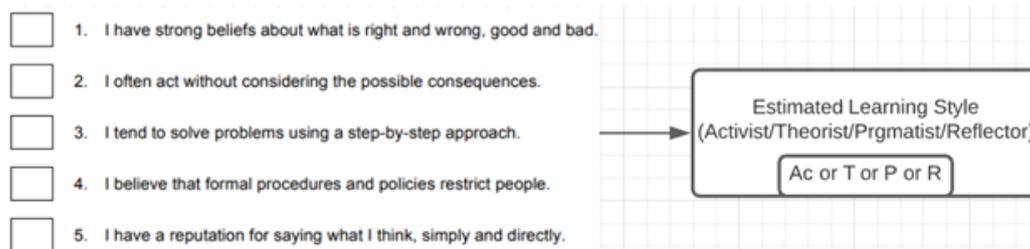


Figure III.5: The Kolb Questionnaire

This model is used in case we failed in identifying the learner’s learning style; the model uses the Kolb Learning Style theories and questionnaire to study the behavior and the experience that the learners have gained through taking a course or a test that they have failed.

**Pedagogical Model**

it is the most important part of the system; it contains the content to teach and all the educational material. It also contains the ability to adapt to the learner’s changing behaviors due to the Adaptation model.

**The Adaptation Model:** it allows the course to be adapted according to the learner's model, this model works as a link between the learner's model and the Pedagogical model. It provides the appropriate course material or the sequences based on the needs and the preference of the learner and the learner's learning style.

### III.3.2 The Detailed Architecture

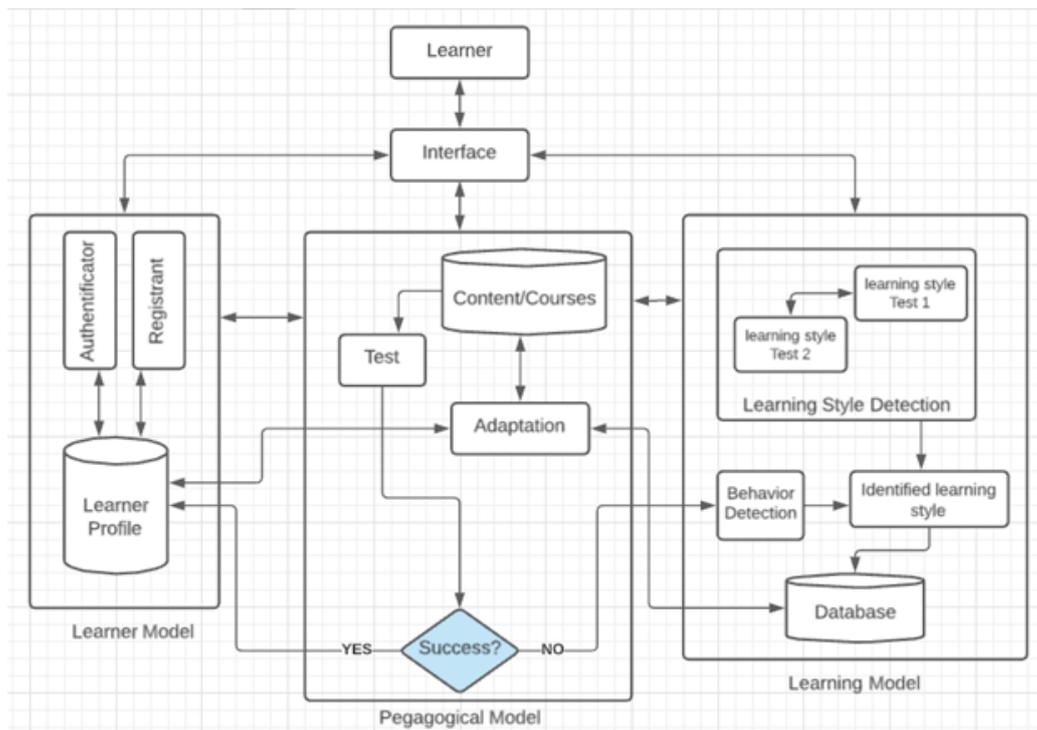


Figure III.6: The detailed architecture of our proposed system

#### Interface

This component can be seen as a mediator or a point of communication between the learner and the system. The interface must have a mechanism for interactive dialogue with the learner to allow him to fully understand what he's getting into and to motivate him to learn.

#### Learner Model

It contains and manages the learner profile or their learning data (preferences, habits, etc.) all stored in the Learner Profile Database. The **Registrant** allows the user to register (create a new account), and if the learner already

has an existing account the **Authenticator** allows them to connect to their existing account by entering their username and password.

### The Learning Model

This model contains three components:

#### The Learning style detection:

this model presents questionnaires of the VARK and the FLSM to determine the learner's learning style preferences.

According to the VARK Questionnaire:

- If the learner's preference is more toward the Visual, the score would be "A".
- If the learner's preference is more toward the Aural, the score would be "B".

We estimate the score based on the learner's answers whether they indicate it's an A or B:

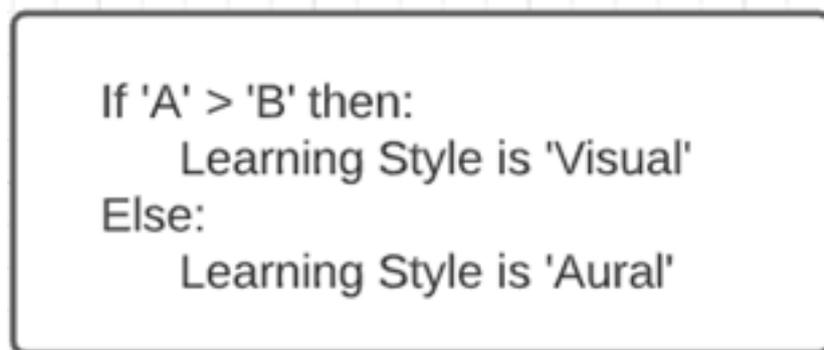


Figure III.7: The Learning Style detection according to the VARK Questionnaire

According to the FLSM ILS Questionnaire:

- If the learner's preference is more toward the Active, the score would be "X".
- If the learner's preference is more toward the Passive, the score would be "Y".

We estimate the score based on the learner's answers whether they indicate it's an X or Y:

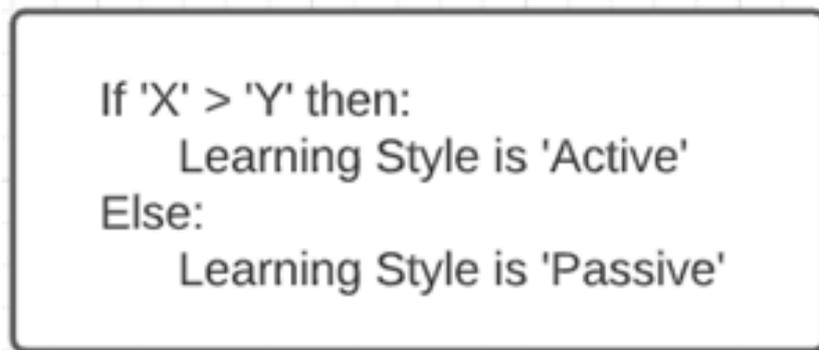


Figure III.8: The Learning Style detection according to the ILS Questionnaire

**The identified learning style:** is a combination of these two scores: (A/X), (A/Y), (B/X), (B/Y) and memorize them and store them in the Database.

If the learner tends to learn with:

- Discussion spaces.
- Audio equipment.
- The exercises.
- Less examples

Then the learner is Aural-Active (B/X)

If the learner tends to learn with:

- Discussion spaces
- Audio equipment
- A course summary
- More Examples
- Less exercises and activities

Then this learner is Aural-Passive (B/Y)

If the learner tends to learn with:

- Pictures, diagrams, maps and charts
- Colors

- Multimedia and animated demonstrations
- The exercises
- Less examples

Then the learner is Visual-Active (A/X)

If the learner tends to learn with:

- Pictures, diagrams, maps, charts
- Colors
- Multimedia and animated demonstrations
- A course summary
- Examples
- Few of the exercises and activities

Then this learner is Visual-Passive (A/Y)

**The Behavior Detection Model:** this model presents the Questionnaire of Kolb that determines the preference of the learners based on their experiences and behaviors.

According to the Kolb Questionnaire:

**ACTIVISTS** want practical tasks and very little theory. They learn best from activities where:

- New experiences are emphasized;
- The focus is on the present and on doing such activities as games, problem solving, simulations;
- There is a lot of action and excitement;
- They can lead and be in the limelight;
- Ideas are generated without any concern about practical constraints;
- they have to respond to a challenge and take risks;
- The central focus is on team problem-solving.

**THEORISTS** want handouts, something to take away and study. They learn best from activities where:

- The learning forms a part of a conceptual whole, such as a model for a theory;
- There is time to explore the interrelationship amongst elements;
- They can explore the theory and methodology underlying the subject under investigation;
- They are intellectually stretched;
- There is a clear and obvious purpose to the activities;
- There is a reliance on rationality and logic;
- They can analyze situations and then generalize their findings;
- They are asked to understand complex situations.

**REFLECTORS** want lots of breaks to go off and read and discuss. They learn best from activities where:

- There are opportunities to observe and consider;
- There is a strong element of passive involvement such as listening to a speaker or watching a video;
- There is time to think before having to act or contribute;
- There is opportunity for research and problems can be probed in some depth;
- They can review what was happening;
- They are asked to produce reports that carefully analyze a situation or issue;
- There is interaction with others without any risks of strong feelings coming to the fore;
- They can finalize a view without being put under pressure.

**PRAGMATISTS** want shortcuts and tips. They learn best from activities where:

- There is a clear link back to some job-related problem;
- Material is directed towards techniques that make their work easier;

- They are able to practice what they have learned;
- They can relate to a successful role model;
- There are many opportunities to implement what has been learned;
- The relevance is obvious and the learning is easily transferred to their jobs;
- What is done is practical such as drawing up action plans or trialing techniques or procedures.

### The Pedagogical Model

It is composed of three components:

**Content:** It contains the educational resources database, the content of these resources is presented in the interface as samples to get the User more interested in taking a course that touches on their interests.

**Test:** It contains a quiz to test whether the learner has understood the adapted course or not. If the learner has passed the quiz, the learning style get saved in the Learner Profile Database, otherwise it does to the Learning style Detection to figure out another learning style that might help more based on the behaviors of the learner.

**Adaptation:** When it comes to the Adaptation we must take the learning resources into consideration to point out the preference of the learner from each learning style. We chose the VARK and FSLSM model, with the VARK model created by Neil Fleming that takes the visual and auditory learning styles to determine what's the preference of the learner whether he would like taking a Textual or Visual course, the we move on to the FSLSM model which retains the Active and Passive styles.

Visual learners prefer to learn with diagrams, maps, flow charts and highlighted texts, so to satisfy their needs we must use the visual devices (photos, graphs, etc...). We can also use colors to attract the learner's attention to the key concepts.

If estimated learning style = "visual":  
then:  
    Integrate images, maps, graphics etc ...  
    Use colors to attract the student's attention  
    Use multimedia and animated demonstrations

Aural students get more from listening, discussion, chatting, records and etc. So to meet their needs we must provide audio material, discussions meetings, explanations, etc.

If estimated learning style = "aural":  
then:  
Integrate audio material  
Provide discussion spaces  
Decrease the use of visual devices

A passive learner tends to like to work alone and learn from examples to understand the general idea. So the learning content must contain examples and summaries.

If estimated learning style = "passive":  
then:  
Integrate the learning resources' summary at the beginning of the pages  
Increase the examples  
Decrease the use of exercises

An active learner tends to learn through practical experiences and theoretical presentation; he likes to work with others to create a sense of competition. So the learning resources must provide exercises, texts and opportunities for group chat, etc.

If estimated learning style = "active":  
then:  
Create discussion spaces  
Increase the use of exercises

When it comes to the Behavior Detection, we calculate the score of the learners' answers that they ticked; each answer insinuates a different type of Learning Style:

	QUESTION NUMBER			
	2	7	1	5
4	13	3	9	
6	15	8	11	
10	16	12	19	
17	25	14	21	
23	28	18	27	
24	29	20	35	
32	31	22	37	
34	33	26	44	
38	36	30	49	
40	39	42	50	
43	41	47	53	
45	46	51	54	
48	52	57	56	
58	55	61	59	
64	60	63	65	
71	62	68	69	
72	66	75	70	
74	67	77	73	
79	76	78	80	
<b>Totals:</b>				
	<b>Activist</b>	<b>Reflector</b>	<b>Theorist</b>	<b>Pragmatist</b>

Each answer indicates to a preference percentage of Learning Style, it can go from a very low preference to very strong preference of Learning Style:

ACTIVIST	REFLECTOR	THEORIST	PRAGMATIST	
20	20	20	20	Very strong preference
19	19	19	19	
18	18	18	18	
17		17	17	
16		16		
15				
14				
13				Strong preference
12	17	15	16	
11	16 15	14	15	
10	14	13	14	Moderate preference
9	13	12	13	
8	12	11	12	
7				
6	11	10	11	Low preference
5	10	9	10	
4	9	8	9	
3	8	7	8	Very low preference
2	7	6	7	
1	6	5	6	
0	5	4	5	
	4	3	4	
	3	2	3	
	2	1	2	
	1	0	1	
	0		0	

### III.4 Scenario Diagrams

In this section, we will describe the different views and scenarios using UML, modeling makes it possible to represent the structure of the proposed system at a level of abstraction that goes beyond the physical implementation of the system.

For this reason, we will present the system in the class diagram and the sequence diagram to explore different scenarios.

## Class Diagram

Class diagrams are used to showcase the structure of the system's components and the links between them. The figure below gives a description to the different classes that take a role in our system as well as the relations between them:

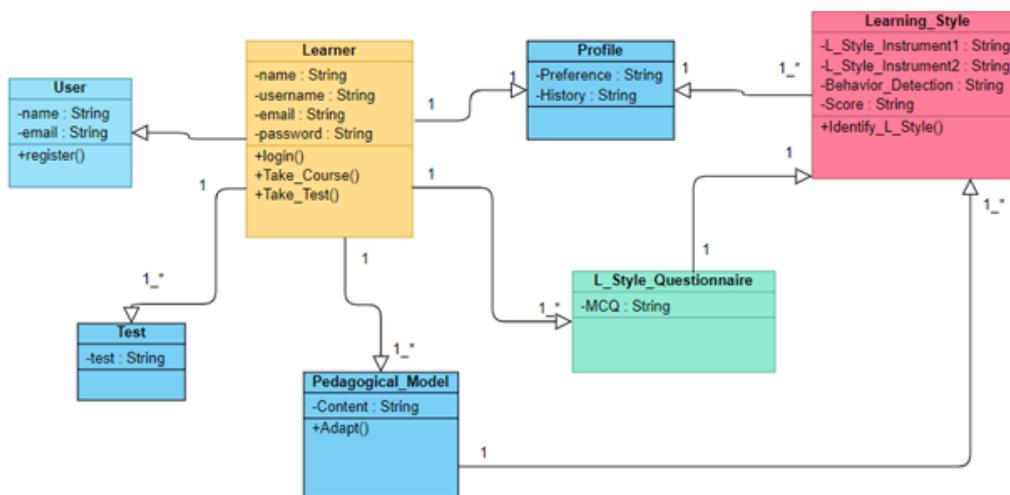


Figure III.9: Class diagram of the User

- User: A user must register their personal information to become a learner in the system.
- Learner: A learner must take the Questionnaire (L\_Style.Questionnaire) so the estimation of their learning style could be possible.
- Profile: Each learner have their own profile that includes the specific details about their learning style and a history of their behavioral changes.
- Pedagogical\_Model: Learners get access to the content to consult a course based on the estimated learning style.
- Learning\_Style: The learning style of the learner is estimated by the Questionnaire which is based on the Learning Style Instruments that detect the learner's preference.

### III.4.1 The Sequence Diagrams

Sequence diagrams are used to describe how the elements of the system interact with each other and with the actors by exchanging messages in a chronological. It is a means used to capture the behavior of entities and actors in the system. The use scenarios of our environment can be represented using the following sequence diagram:

#### Scenario 1: Creating an account

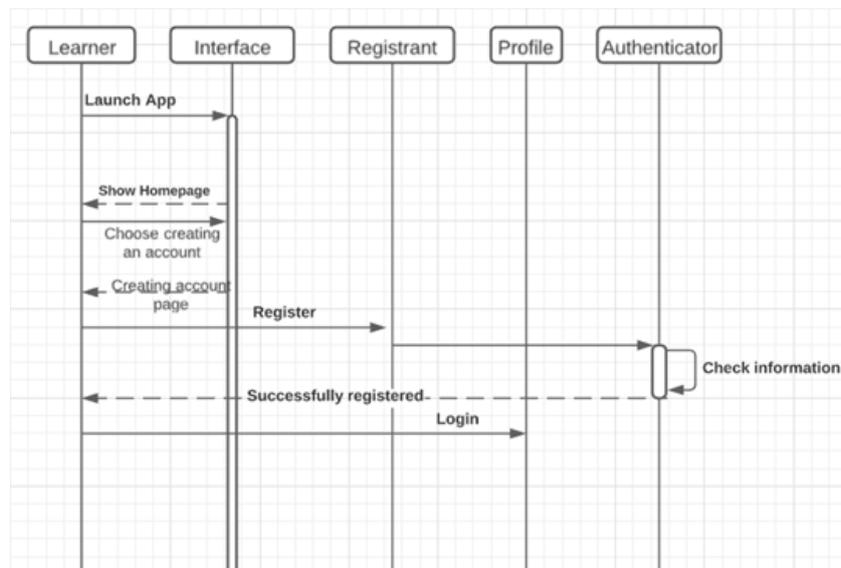


Figure III.10: The Sequence diagram of Creating an account in the system

**Scenario 2: Signing in to an existing account**

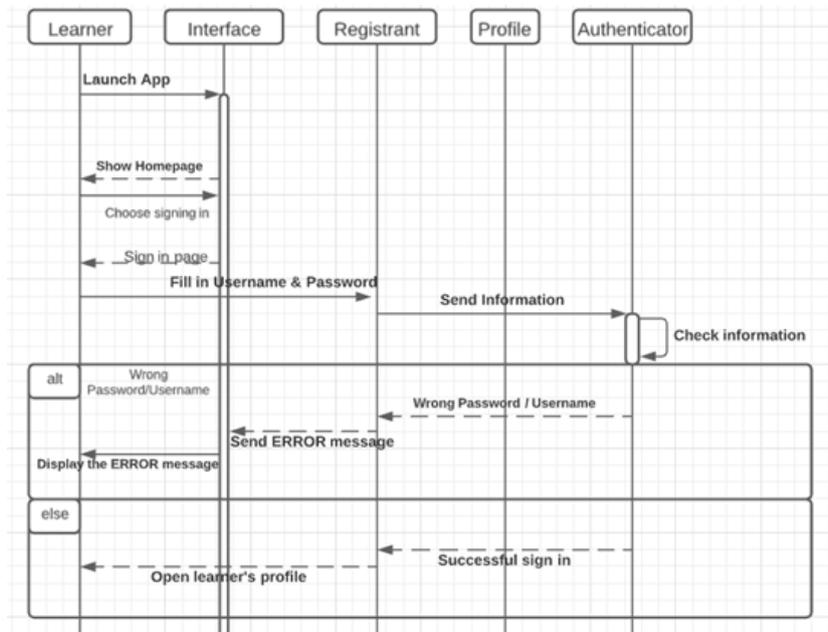


Figure III.11: The Sequence diagram of signing to an account in the system

**Scenario 3: Launching a course**

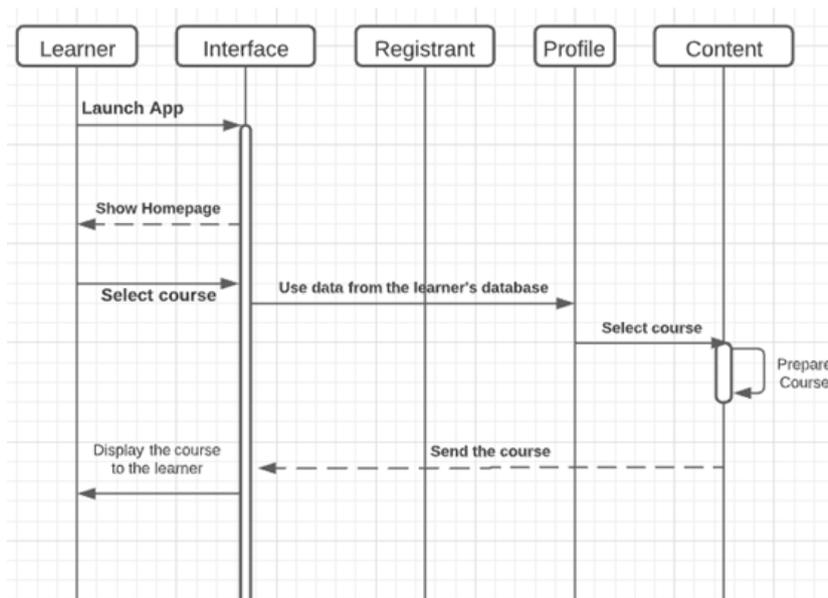


Figure III.12: The Sequence diagram of launching a course

The General Sequence Diagram

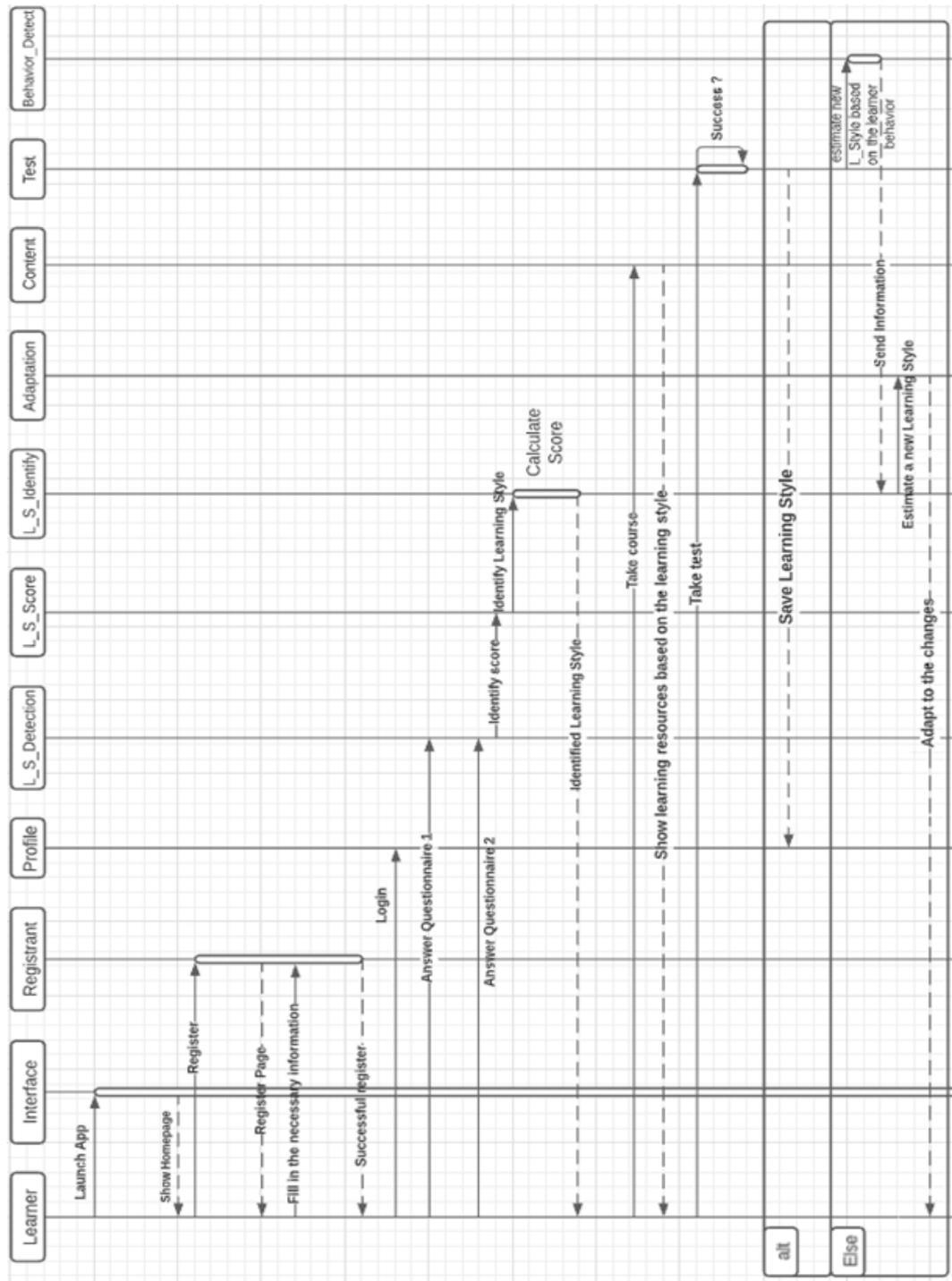


Figure III.13: The general Sequence diagram of the proposed system

## **III.5 Conclusion**

In this chapter, we have represented the general architecture of our system that consists of a learner model, pedagogical model, learning model and an Interface; then we detailed this architecture by giving a description and the function of each component and we suggested some different scenarios of our system.

# Chapter IV

## Implementation

### IV.1 Introduction

We presented in the previous chapter the design of our system which makes it possible to adapt the educational content to all learners, in this chapter we are going to dive into the implementation side of our application. We will present the tools and the languages that have been used for the realization of the proposed system.

### IV.2 The Used Tools

#### Python



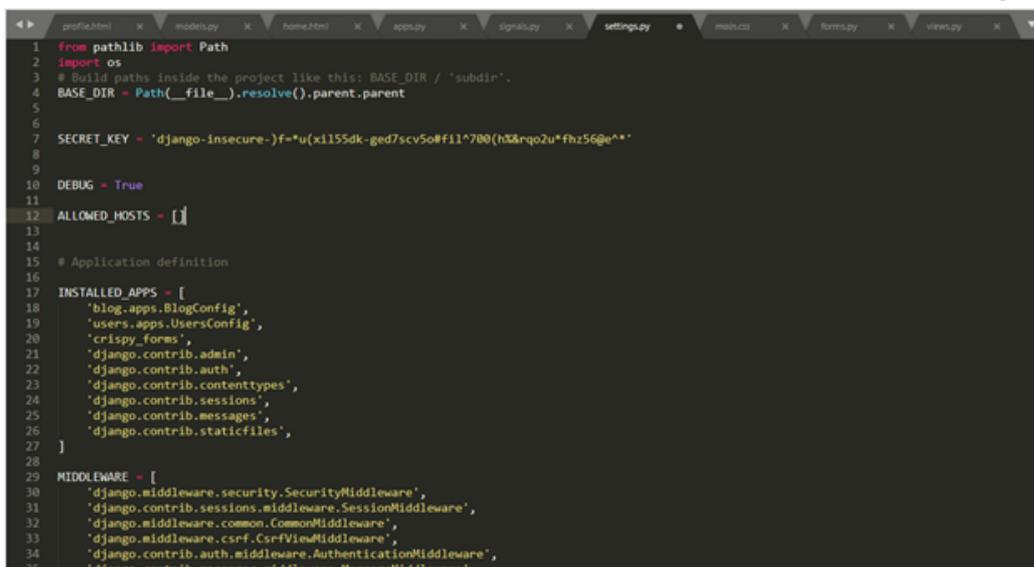
Python is a high-level, interpreted, interactive and object-oriented scripting language. Python is designed to be highly readable.

It uses English keywords frequently where as other languages use punctuation, and it has fewer syntactical constructions than other languages.[39]

- Python is interpreted: Python is processed at runtime by the interpreter. You do not need to compile your program before executing it. This is similar to PERL and PHP.
- Python is Interactive: You can actually sit at a Python prompt and interact with the interpreter directly to write your programs.
- Python is Object-Oriented: Python supports Object-Oriented style or technique of programming that encapsulates code within objects.

- Python is a Beginner’s Language: Python is a great language for the beginner-level programmers and supports the development of a wide range of applications from simple text processing to WWW browsers to games.

Python is dynamically-typed and garbage-collected. It supports multiple programming paradigms, including structured (particularly, procedural), object-oriented and functional programming. Python is often described as a ”batteries included” language due to its comprehensive standard library.[40]



```
1 from pathlib import Path
2 import os
3 # Build paths inside the project like this: BASE_DIR / 'subdir'.
4 BASE_DIR = Path(__file__).resolve().parent.parent
5
6
7 SECRET_KEY = 'django-insecure-)f=*u(x1155dk-ged7scv5o#f11*700(h3&rqq2u*fhz56@e**'
8
9
10 DEBUG = True
11
12 ALLOWED_HOSTS = []
13
14
15 # Application definition
16
17 INSTALLED_APPS = [
18     'blog.apps.BlogConfig',
19     'users.apps.UsersConfig',
20     'crispy_forms',
21     'django.contrib.admin',
22     'django.contrib.auth',
23     'django.contrib.contenttypes',
24     'django.contrib.sessions',
25     'django.contrib.messages',
26     'django.contrib.staticfiles',
27 ]
28
29 MIDDLEWARE = [
30     'django.middleware.security.SecurityMiddleware',
31     'django.contrib.sessions.middleware.SessionMiddleware',
32     'django.middleware.common.CommonMiddleware',
33     'django.middleware.csrf.CsrfViewMiddleware',
34     'django.contrib.auth.middleware.AuthenticationMiddleware',
35     'django.contrib.messages.middleware.MessageMiddleware',
```

Figure IV.1: Screenshot of a Python file

## Django

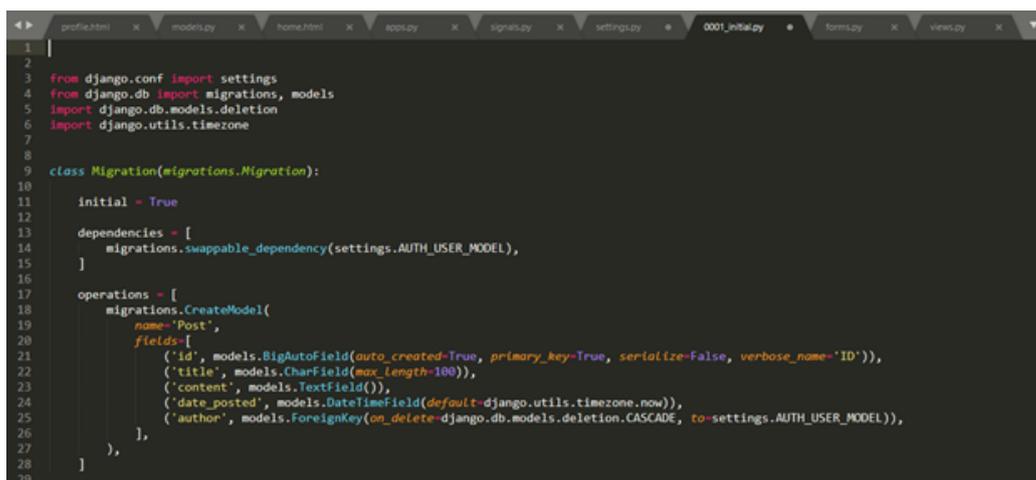
**django** Django is a web development framework that assists in building and maintaining quality web applications. Django helps eliminate repetitive tasks making the development process an easy and time saving experience.[39]

Django is a high-level Python web framework that encourages rapid development and clean, pragmatic design. Django makes it easier to build better web apps quickly and with less code.[39]

Django’s primary goal is to ease the creation of complex, database-driven websites. The framework emphasizes reusability and ”pluggability” of components, less code, low coupling, rapid development, and the principle of don’t repeat yourself. Python is used throughout, even for settings, files, and data models. Django also provides an optional administrative create, read, update and delete interface that is generated dynamically through introspection and configured via admin models.[40]

With Django, you can take Web applications from concept to launch in a matter of hours. Django takes care of much of the hassle of Web development, so you can focus on writing your app without needing to reinvent the wheel. It's free and open source.[41]

- Extremely fast: Django was designed to help developers take applications from concept to completion as quickly as possible.
- Fully loaded: Django includes dozens of extras you can use to handle common Web development tasks. Django takes care of user authentication, content administration, site maps, RSS feeds, and many more tasks — right out of the box.
- Reassuringly secure: Django takes security seriously and helps developers avoid many common security mistakes, such as SQL injection, cross-site scripting, cross-site request forgery and clickjacking. Its user authentication system provides a secure way to manage user accounts and passwords.
- Exceedingly scalable: Some of the busiest sites on the planet use Django's ability to quickly and flexibly scale to meet the heaviest traffic demands.
- Incredibly versatile: Companies, organizations and governments have used Django to build all sorts of things — from content management systems to social networks to scientific computing platforms.

A screenshot of a code editor showing a Django migration file. The code defines a class Migration that inherits from migrations.Migration. It sets initial = True and lists dependencies, including a swappable\_dependency on settings.AUTH\_USER\_MODEL. The operations list includes a CreateModel operation for a 'Post' model with fields: id (BigAutoField), title (CharField), content (TextField), date\_posted (DateTimeField), and author (ForeignKey to settings.AUTH\_USER\_MODEL).

```
1 |
2 |
3 | from django.conf import settings
4 | from django.db import migrations, models
5 | import django.db.models.deletion
6 | import django.utils.timezone
7 |
8 |
9 | class Migration(migrations.Migration):
10 |
11 |     initial = True
12 |
13 |     dependencies = [
14 |         migrations.swappable_dependency(settings.AUTH_USER_MODEL),
15 |     ]
16 |
17 |     operations = [
18 |         migrations.CreateModel(
19 |             name='Post',
20 |             fields=[
21 |                 ('id', models.BigAutoField(auto_created=True, primary_key=True, serialize=False, verbose_name='ID')),
22 |                 ('title', models.CharField(max_length=100)),
23 |                 ('content', models.TextField()),
24 |                 ('date_posted', models.DateTimeField(default=django.utils.timezone.now)),
25 |                 ('author', models.ForeignKey(on_delete=django.db.models.deletion.CASCADE, to=settings.AUTH_USER_MODEL)),
26 |             ],
27 |         ),
28 |     ]
29 |
```

Figure IV.2: Screenshot of a Django file

## HTML



The HTML language, HyperText Markup Language, was introduced in 1990. HTML is defined by the W3C2, World Wide Web consortium. Its role is to formalize the writing of a document with formatting tags, which are used to indicate how they should be presented the document and the links it establishes with other documents. This is a particular annotation type intended for the WWW and which corresponds to a collection of styles recognizable by browsers. Therefore, the browser is software that interprets on the screen the HTML commands contained in a document accessible on the WWW.

In other words, HTML is a set of tags used to define the different components of a document. HTML documents are ASCII texts punctuated by `<TAG>` sequences and `<TAG>`. The tags of the HTML page mar an action for the browser ad specify the modalities by attributes. Since HTML is a set of tags and attributes, it seems useful to review them. The HTML language allows the reading of documents on the internet from different machines.

 A screenshot of a code editor showing an HTML file. The editor has a dark background with light-colored text. The code is as follows:
 

```

1  {% load static %}
2  <!DOCTYPE html>
3  <html>
4  <head>
5      <!-- Required meta tags -->
6      <meta charset="utf-8">
7      <meta name="viewport" content="width=device-width, initial-scale=1, shrink-to-fit=no">
8
9      <!-- Bootstrap CSS -->
10     <link rel="stylesheet" href="https://maxcdn.bootstrapcdn.com/bootstrap/4.0.0/css/bootstrap.min.css" integrity="
11     sha384-Gn5384xqQ1aoKOA+05SRXp66fy4DwVNH0E263Xmfc3J54wI6GFAM/dA1563Xm" crossorigin="anonymous">
12
13     <link rel="stylesheet" type="text/css" href="{% static 'blog/main.css' %}">
14
15
16
17
18     {% if title %}
19     <title>Django Blog - {{ title }}</title>
20     {% else %}
21     <title>Django Blog</title>
22     {% endif %}
23 </head>
24 <body>
25     <header class="site-header">
26     <nav class="navbar navbar-expand-md navbar-dark bg-steel fixed-top">
27     <div class="container">
28     <a class="navbar-brand mr-4" href="{% url 'blog-home' %}">Django Blog</a>
29     <button class="navbar-toggler" type="button" data-toggle="collapse" data-target="#navbarToggle" aria-controls="navbarToggle"
30     aria-expanded="false" aria-label="Toggle navigation">
31     <span class="navbar-toggler-icon"></span>
32     </button>
33     <div class="collapse navbar-collapse" id="navbarToggle">

```

Figure IV.3: Screenshot of an HTML file

## SQL

SQL stands for Structured Query Language. SQL is used to communicate with a database. According to ANSI (American National Standards Institute), it is the standard language for relational database management systems. SQL statements are used to perform tasks such as update data on a database, or retrieve data from a database.

Some common relational database management systems that use SQL are: Oracle, Sybase, Microsoft SQL Server, Access, Ingres, etc. Although most database systems use SQL, most of them also have their own additional proprietary extensions that are usually only used on their system. However, the standard SQL commands such as "Select", "Insert", "Update", "Delete", "Create", and "Drop" can be used to accomplish almost everything that one needs to do with a database.

## CSS

The CSS language, Cascading Style Sheets, was developed in 1996 to compensate for lack of HTML with regard to layout and presentation. The role of CSS is to manage the appearance of the web page: layout, positioning, decoration, colors, text size, etc. The principle of style sheets is to group together in a single document of the formatting characteristics associated with groups of elements. Style sheets improve the graphics and therefore the ergonomics of hypermedia; they are today's standardized layout system for web pages, used by the majority of web designers.

## Bootstrap

Bootstrap is the most popular open-source front-end framework. It is developed by Mark Otto, Jacob Thornton 19 August 2011. Bootstrap is a collection of CSS classes and JavaScript function and it is used for responsive design and building responsive, mobile-first site and application. It generally works on a grid system for creating page layout with the help of rows and columns and it supports all browsers for creating responsive websites.

Bootstrap is a free and open-source CSS potent front-end Framework use to create modern websites and web applications. It features numerous HTML and CSS templates for UI interface elements such as buttons and forms. Bootstrap also supports JavaScript extensions.

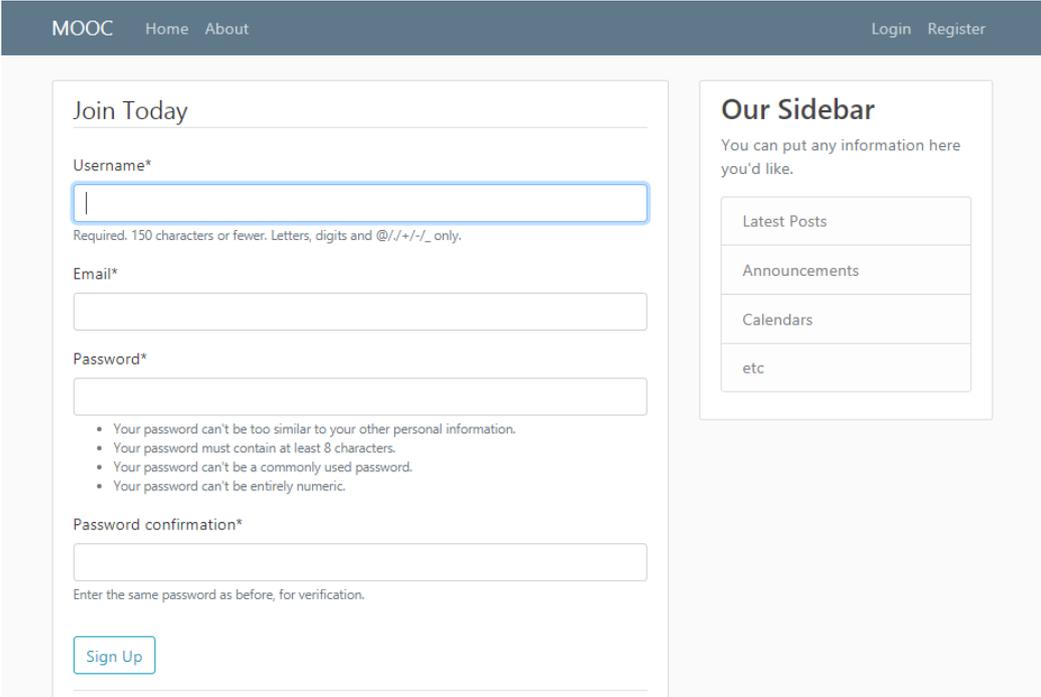
## Tailwind CSS

Tailwind is a utility-first CSS framework. In contrast to other CSS frameworks like Bootstrap or Materialize CSS it doesn't come with predefined components. Instead Tailwind CSS operates on a lower level and provides you with a set of CSS helper classes. By using this classes you can rapidly create custom design with ease. Tailwind CSS is not opinionated and let's you create you own unique design.

## IV.3 Results

We will present here an overview of the different results obtained:

### 1.Registration of a new learner



The screenshot shows a registration form for a MOOC platform. The header includes 'MOOC' and navigation links 'Home' and 'About' on the left, and 'Login' and 'Register' on the right. The main content area is divided into two columns. The left column is titled 'Join Today' and contains a registration form with the following fields and instructions:

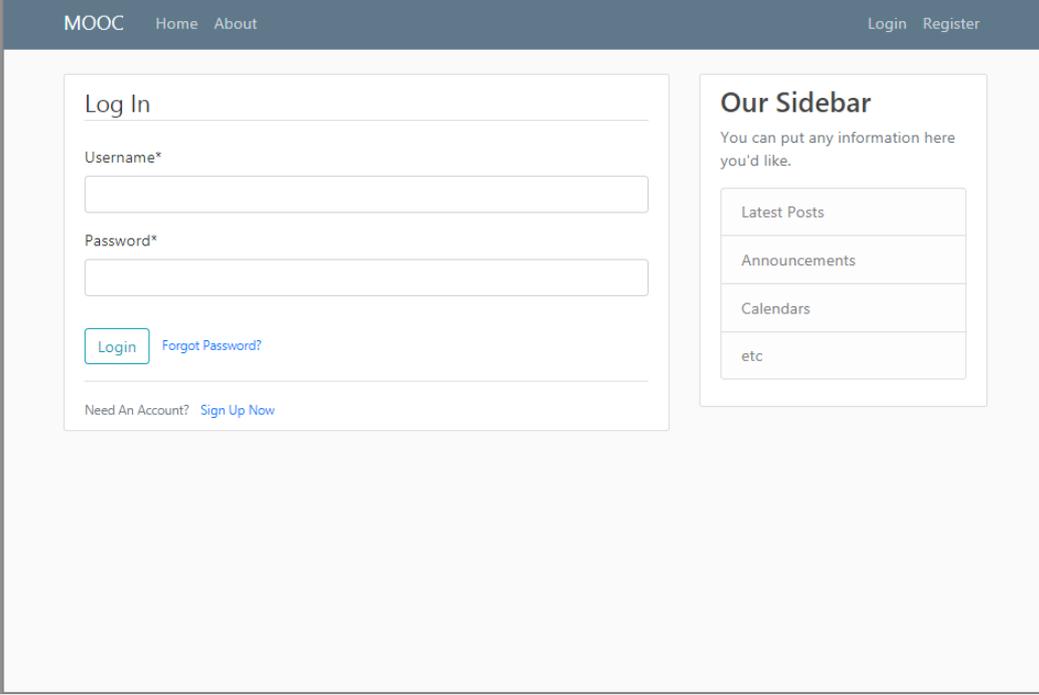
- Username\***: A text input field with a blue border. Below it, the text reads: "Required. 150 characters or fewer. Letters, digits and @/./+/-/\_ only."
- Email\***: A text input field.
- Password\***: A text input field. Below it, a list of password requirements is shown:
  - Your password can't be too similar to your other personal information.
  - Your password must contain at least 8 characters.
  - Your password can't be a commonly used password.
  - Your password can't be entirely numeric.
- Password confirmation\***: A text input field. Below it, the text reads: "Enter the same password as before, for verification."

At the bottom of the form is a 'Sign Up' button. The right column is titled 'Our Sidebar' and contains the text: "You can put any information here you'd like." Below this text is a list of sidebar options: 'Latest Posts', 'Announcements', 'Calendars', and 'etc'.

Figure IV.4: Learner registration interface.

### 2.Logging to an existing account

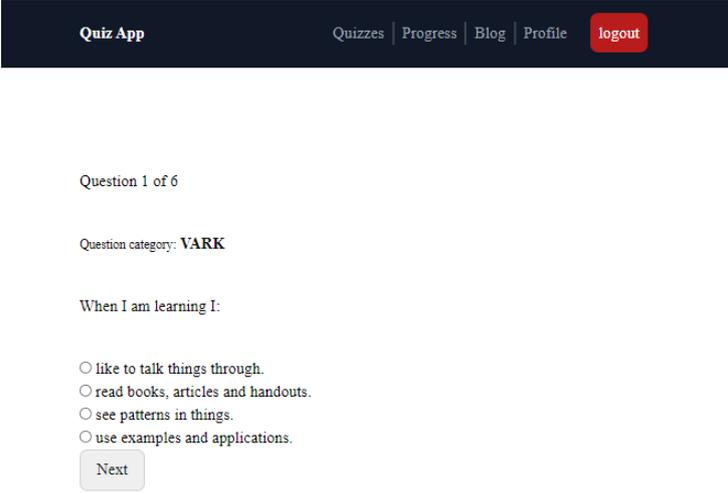
If the learner is already registered, then he connects to his existing account.



The screenshot shows a web interface for a MOOC. At the top, there is a dark blue navigation bar with the text "MOOC" on the left and "Home About" in the middle. On the right side of the navigation bar, there are links for "Login" and "Register". Below the navigation bar, the main content area is divided into two columns. The left column is titled "Log In" and contains a form with two input fields: "Username\*" and "Password\*". Below these fields are two buttons: "Login" and "Forgot Password?". At the bottom of the form, there is a link "Need An Account? Sign Up Now". The right column is titled "Our Sidebar" and contains the text "You can put any information here you'd like." Below this text is a list of items: "Latest Posts", "Announcements", "Calendars", and "etc".

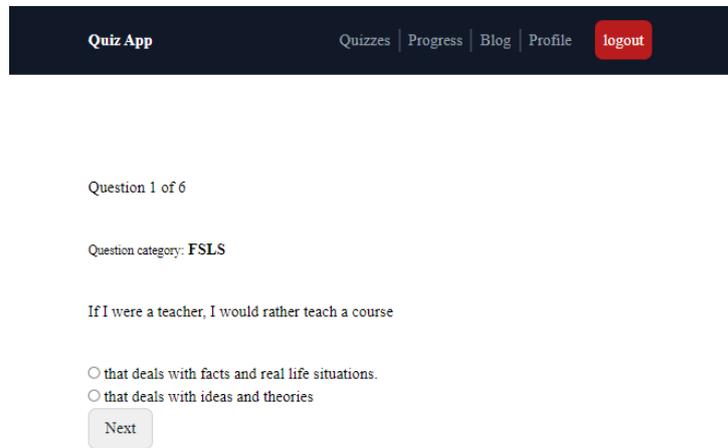
Figure IV.5: Learner login interface.

### 3. Estimating the Learning Style



The screenshot shows a web interface for a learning style estimation questionnaire. At the top, there is a dark blue navigation bar with the text "Quiz App" on the left and "Quizzes | Progress | Blog | Profile" in the middle. On the right side of the navigation bar, there is a red button labeled "logout". Below the navigation bar, the main content area is white. It starts with the text "Question 1 of 6". Below this is the text "Question category: VARK". Then, it asks "When I am learning I:". Below this question are four radio button options: "like to talk things through.", "read books, articles and handouts.", "see patterns in things.", and "use examples and applications.". At the bottom of the form, there is a "Next" button.

Figure IV.6: Learning style estimation VARK questionnaire interface



Quiz App

Quizzes | Progress | Blog | Profile | **logout**

Question 1 of 6

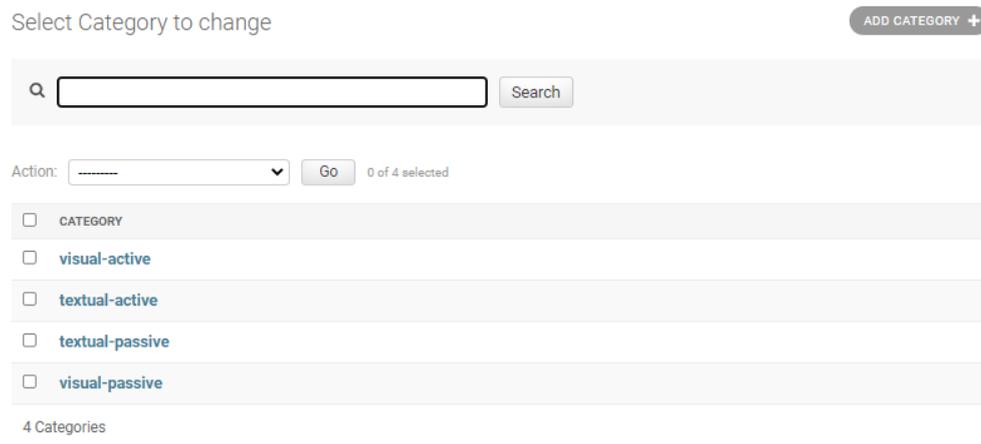
Question category: **FSLS**

If I were a teacher, I would rather teach a course

that deals with facts and real life situations.  
 that deals with ideas and theories

Next

Figure IV.7: Learning style estimation FLSM questionnaire interface



Select Category to change ADD CATEGORY +

Q  Search

Action:  Go 0 of 4 selected

- CATEGORY
- visual-active
- textual-active
- textual-passive
- visual-passive

4 Categories

Figure IV.8: Learning style categories

### Admin Homepage

this page allows the admin to hold control of the website and authorize every action:

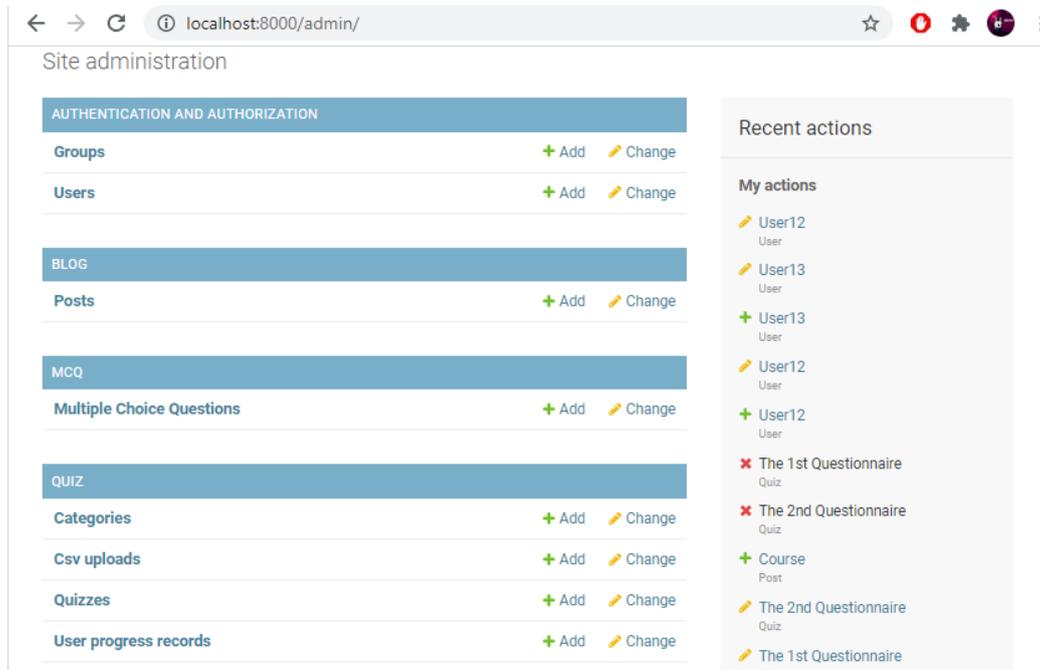


Figure IV.9: Admin Homepage

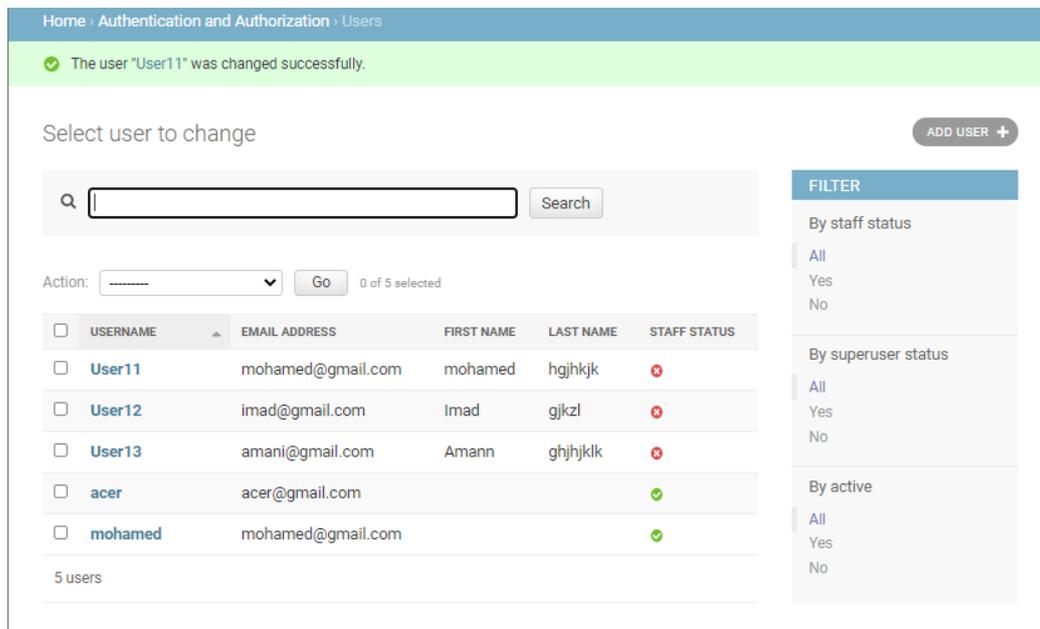


Figure IV.10: The saved data in the admin page

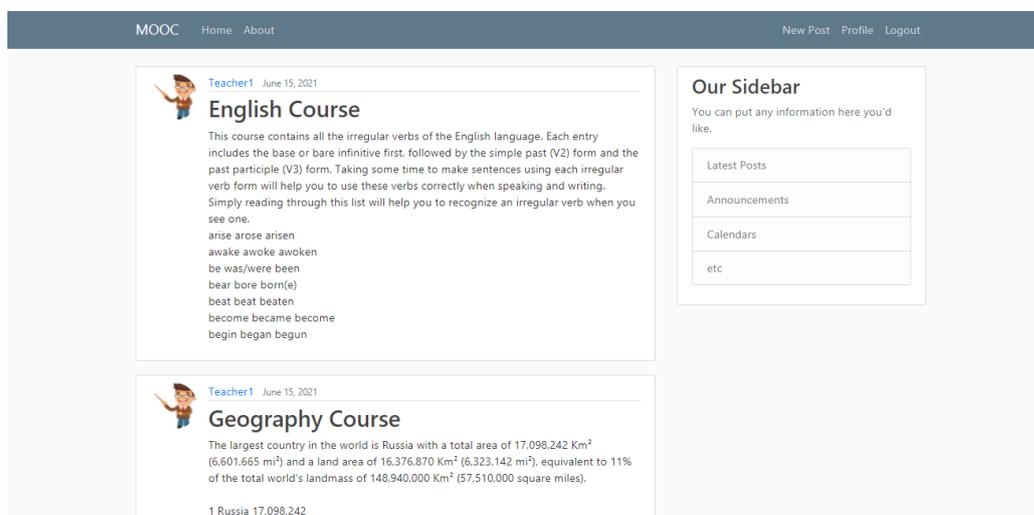


Figure IV.11: The home page

The learner can only access to this page after logging in, this page contains the courses uploaded by the **Teacher** and authorized by the **Admin**.

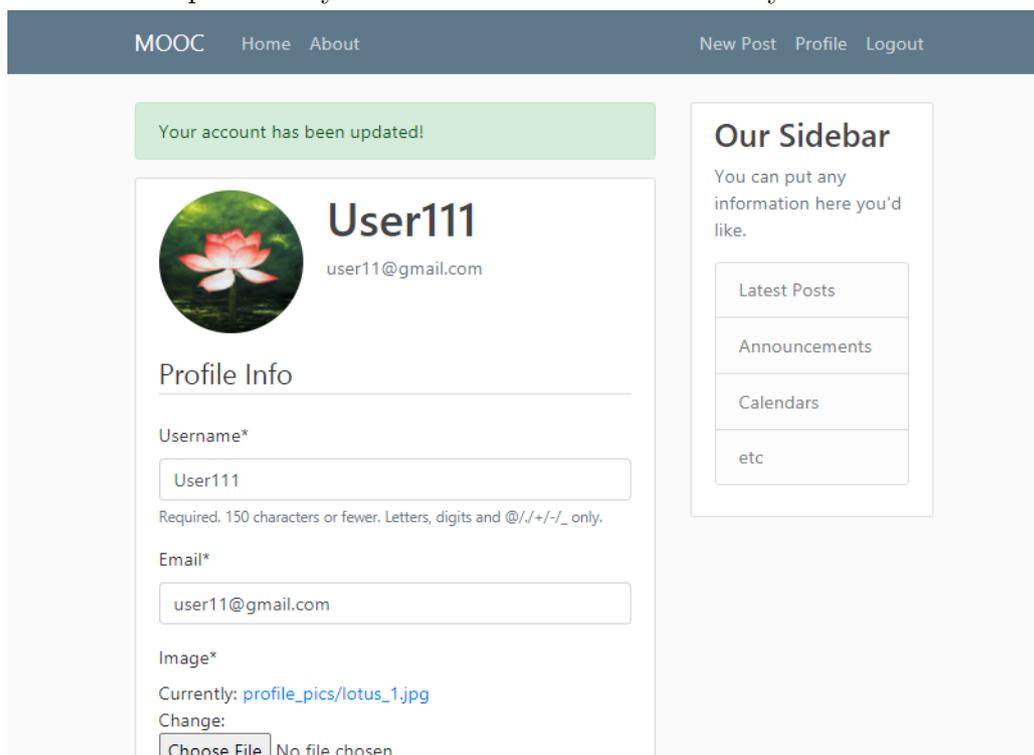


Figure IV.12: The user profile page

This page contains the personal data of the user, only he/she can get access to this page and update it.



Figure IV.13: A textual-passive English Test

What is the past participle of the verb "Draw"!

Your answer was **correct**

Drawed	
Drawn	<b>This is the correct answer</b>
Drew	

**Explanation:**

The correct answer was "Drawn"

## Exam results

Exam title: **English Test**

You answered 3 questions correctly out of 3, giving you 100 percent correct

Review the questions below and try the exam again in the future.

The result of this exam will be stored in your progress section so you can review and monitor your progression.

Figure IV.14: A textual-passive English Test Evaluation



## Question Category Scores

CATEGORY	CORRECTLY ANSWERED	INCORRECT	%
visual-passive	2	2	100
textual-passive	2	3	67
textual-active	0	0	0
visual-active	0	0	0

Figure IV.15: Question Category Scores

## IV.4 Conclusion

In this chapter, we have focused our interest on the development of our MOOC system that adapts the learning styles of learners. We presented the practical aspect of our project in terms of the proposed system, implementation and the obtained results. Finally, we established correspondences between the learning style according to the two models one of Fleming and the other of Felder-Silverman and the learning resources to improve online learning. Our work can be extensible and enhanced for better service and we wished we added more features.

# General Conclusion

The main objective of this thesis is the proposal of an approach for the creation of a learning system depending on the learning style of the learners to meet their objectives and optimize academic gain. This thesis was carried out according to an approach comprising four main phases:

- Identification of issues resulting from adaptation techniques that do not do not take into account the learning style of the learner in an application adaptive learning
- Show the interest of an architecture that provides the functions of a dynamic and adaptive learning system that is capable of satisfying the learners individually.
- Estimation of the learner's learning styles in Online Learning Systems using the learning style instruments, We have chosen in this thesis the two learning styles (visual and auditory) of Fleming's psychological model (VARK) to detect how the learner prefers to receive new information, and two other learning styles (active and passive) of the Felder-Silverman model to find out how the learner processes the information. And by making a combination between these two models. We also considered using Kolb's learning style model to detect the learner's behavior.
- Creation of learning resources based on individual's preferences of the estimated learning style, so that they are relevant to the learner's profile.

For these objectives, we proceeded as follows:

We have shown the weaknesses of the adaptation techniques that do not take into account the individual preferences of Learners. Therefore, we have shown the interest of adaptation techniques based on learning styles. For this, we have given a general view of the different learning style models, We have shown that adapting a course to learning styles allowed easy learning and learner satisfaction.

We chose two learning style models, one from Fleming (VARK) and the other from Felder-Silverman (FSLSM) to better identify the learning style of the learner, we've chosen VARK because it is competent to estimate the learning style of the learner. Thus, it exhibits a good degree of validity, reliability, simplicity and consistency. This model has been widely used in adaptive learning applications. In addition, it has a significant influence on the learning process according to educational psychology.

As we also chose the Felder-Silverman model for several reasons: this model is the most commonly used in the literature. It is suggested as the most suitable model for adaptive Online learning systems to provide style-based adaptation learning.

We developed questionnaires for the estimation of learning style, the implemented questionnaire of Fleming's VARK learning style model allows to pinpoint the dominant preference according to the two dimensions of Fleming's model: visual, auditory, and the Felder-Silverman questionnaire which includes ten questions allowing to know the dominant preference according to the two dimensions of the Felder-Silverman model: active, passive. Once the two learning styles are estimated, the system combines them.

After estimating the learning style, the learner will be invited to access the relevant resources to his interest and research objective and adapted to his learning style. So, the user must go through a course evaluation test. In order to know if the learning style is appropriate with him or not. If the learner was successful in this test then the style learning will be saved in their profile.

Otherwise, the learner would go through another questionnaire inspired by Kolb's learning style to detect their behavior and come up with more accurate learning style, this surely would allow to refine and complete the description of their preferred learning style.



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