الجمهورية الجزائرية الديمقراطية الشعبية
The People's Democratic Republic of Algeria
وزارة التعليم العالي والبحث العلمي
Ministry of Higher Education and Scientific Research
جامعة محمد بوضياف بالمسيلة
University Mohamed Boudiaf of M'sila

جامعة محمد بوضياف - المسيلة
Université Mohamed Boudiaf - M'sila

كلية الرياضيات والإعلام الآلي
Faculty of Mathematics and Informatics

قسم الإعلام الآلي
Department of Computer Science

Domain: Mathematics and Computer Science

Thesis Presented to Fulfill the Partial Requirement
for Master's Degree in Computer Science

Specialty: Information systems and software engineering

Prepared By: Amroune Houssam Eddine

Supervised By:

Pr.Akhrouf Samir

ENTITLED

A digital academy to learn programming, artificial intelligence and IT filde

Jury Members

Dr.Said Kadri	President
Pr .Samir Akhrouf	Supervisor
Dr. Mohamed Bounif	Examiner

Academic Year 2025

Dedication

أُهدي هذا العمل إلى عائلتي الغالية، التي كانت ولا تزال نبض قلبي وقوة روحي، وسندي الذي لا ينكسر في كل مراحل حياتي.

إلى والديّ الحبيبين، اللذان كانت تضحياتهما العظيمة، وحكمتهما الثمينة، وحبهما الذي لا ينضب، كالنور الذي أضاء لي دروب الحياة، وكانا الدافع الحقيقي الذي منحني القوة لأواصل المسير وأحقق أحلامي.

وإلى إخوتي وأخواتي الأعزاء، شكراً من القلب على دعمكم الذي لا يتوقف، وتشجيعكم الذي يملأ قلبي دفئًا، وثقتكم التي كانت لي ملاذًا في أصعب اللحظات.

وإلى كل من يحمل مكانة خاصة في قلبي، وجودكم في حياتي كان أجمل هدية، ونعمة لا تقدر بثمن خلال هذه الرحلة العلمية التي لا أنساها.

عمرون حسام الدين

Acknowledgement

I would like to express my sincere and heartfelt gratitude to my supervisor, Professor Samir Akhrouf, for his invaluable guidance, continuous support, and insightful advice throughout the development of this thesis. His dedication, academic rigor, and encouragement played a crucial role in shaping the direction and quality of my work.

I am also deeply thankful to the respected members of the jury for their time, constructive feedback, and thoughtful remarks, which have significantly contributed to the enhancement of this research.

Special thanks are also due to the entire faculty and staff of the Department of Computer Science at Mohamed Boudiaf University of M'sila for providing a motivating and supportive academic environment during my years of study.

Abstract:

In this rapidly changing digital world, education systems across the globe have seen profound transformations, notably in response to the COVID-19 pandemic. The pandemic not only revealed the limitations of typical in-person educational experiences but also illuminated the bright light of scalable, inclusive innovation in digital learning. Against this backdrop, Algeria (like many other developing countries) faces enormous challenges when trying to provide modern IT education that fits the growing demand of an increasingly digital workforce, and the competitive demands of a global job market.
This thesis proposes a systematic design for a digital academy focused on programming, artificial intelligence (AI), and information technology (IT), specifically in the Algerian context. The platform aims to develop a bridge between traditional education and the need for practical, accessible, and high-quality technical training, by offering a holistic educational ecosystem comprised of an advanced Learning Management System (LMS), interactive course content, real-time assessment, and community-based engagement, all presented in both Arabic and English.

The research begins with the literature review that highlights digital learning platforms globally, in the Arab world, and in Algeria; and describes the implications of important strengths, weaknesses, and shortcomings to the online presence contents and their structure, user experience, pedagogical design, and potential improvements to align with the developing needs of labor markets. An analysis of the original platforms was conducted using qualitative and quantitative analyses which provided a detailed comparison of the existing educational systems in Algeria which are unstructured, offer little interactivity and are unsecured for financial transactions, as all educational offerings were relying on social media access links (Facebook, YouTube) or online learning materials (educational resources, references, documents).

Informed by the analysis, a rigorous requirements analysis was then conducted, to develop a valid set of functional and non-functional requirements and specifications, while also adapting the recommendations to suit the sociotechnical particularities of the context of Algeria. These included access to limited infrastructure particularly in rural areas, linguistic and cultural diversity including the Arabic and Tamazight languages, and aligning curriculum design with the national strategy for digital transformation and a youth employment strategy.

The platform and architecture represent good brief design choices to create the modular, scalable development model discussed in the literature review using the Waterfall development model. The unrestricted multi-featured LMS and the existing online transaction payment system; online and home care tutorials; progress boards and tracking functions; a variety of collaborative features, such as discussion forums, live chat, and the development of multiple types of course offerings in programming and artificial intelligence. Other issues such as access to the LMS; access to multilingual environments; access that is mobile compatible; and ensuring inclusivity and accessibility across a range of users were also resolved.

Ultimately, this thesis advocates for a sustainable, locally relevant digital learning model that not only enhances technical education in Algeria but also supports national goals in economic development, digital sovereignty, and human capital formation. The proposed digital academy represents a foundational step towards a more connected, skilled, and

digitally empowered Algerian society. Future work will focus on platform implementation, pilot testing with real users, and continuous improvement based on feedback and evolving technological trends.

Résumé :

Dans ce monde numérique en rapide évolution, les systèmes éducatifs du monde entier ont connu de profondes transformations, notamment en réponse à la pandémie de COVID-19. Cette pandémie a non seulement révélé les limites des expériences éducatives classiques en présentiel, mais a également mis en lumière l'importance d'une innovation évolutive et inclusive dans l'apprentissage numérique. Dans ce contexte, l'Algérie (comme de nombreux autres pays en développement) est confrontée à d'énormes défis pour offrir une formation informatique moderne, adaptée à la demande croissante d'une main-d'œuvre de plus en plus numérique et aux exigences concurrentielles d'un marché du travail mondial.
Cette thèse propose une conception systématique d'une académie numérique axée sur la programmation, l'intelligence artificielle (IA) et les technologies de l'information (TI), spécifiquement dans le contexte algérien. La plateforme vise à créer un pont entre l'éducation traditionnelle et le besoin d'une formation technique pratique, accessible et de haute qualité, en offrant un écosystème éducatif holistique comprenant un système de gestion de l'apprentissage (LMS) avancé, des contenus de cours interactifs, une évaluation en temps réel et un engagement communautaire, le tout présenté en arabe et en anglais.

La recherche commence par une revue de la littérature mettant en évidence les plateformes d'apprentissage numérique à l'échelle mondiale, dans le monde arabe et en Algérie ; Français et décrit les implications des forces, faiblesses et lacunes importantes concernant les contenus de la présence en ligne, leur structure, l'expérience utilisateur, la conception pédagogique et les améliorations potentielles pour les adapter aux besoins changeants du marché du travail. Une analyse des plateformes originales a été menée à l'aide d'analyses qualitatives et quantitatives. Celles-ci ont fourni une comparaison détaillée des systèmes éducatifs existants en Algérie, lesquels sont non structurés, offrent peu d'interactivité et ne sont pas sécurisés pour les transactions financières, car toutes les offres éducatives reposaient sur des liens d'accès aux réseaux sociaux (Facebook, YouTube) ou sur des supports d'apprentissage en ligne (ressources pédagogiques, références, documents).

Sur la base de cette analyse, une analyse rigoureuse des besoins a ensuite été réalisée afin d'élaborer un ensemble valide d'exigences et de spécifications fonctionnelles et non fonctionnelles, tout en adaptant les recommandations aux particularités sociotechniques du contexte algérien. Ces recommandations comprenaient l'accès à des infrastructures limitées, notamment en zones rurales, la diversité linguistique et culturelle, notamment l'arabe et le tamazight, et l'alignement de la conception des programmes d'études sur la stratégie nationale de transformation numérique et la stratégie pour l'emploi des jeunes.

La plateforme et l'architecture représentent des choix de conception judicieux pour créer le modèle de développement modulaire et évolutif présenté dans la revue de littérature, utilisant le modèle de développement en cascade. Le LMS polyvalent et illimité et le système de paiement en ligne existant ; les tutoriels en ligne et à domicile ; les tableaux de progression et les fonctions de suivi ; diverses fonctionnalités collaboratives, telles que les forums de discussion, le chat en direct, et le développement de multiples types de cours en

programmation et en intelligence artificielle. D'autres problématiques, telles que l'accès au LMS ; l'accès à des environnements multilingues ; la compatibilité mobile ; et la garantie d'inclusion et d'accessibilité pour un large éventail d'utilisateurs, ont également été résolues.

En fin de compte, cette thèse prône un modèle d'apprentissage numérique durable et pertinent au niveau local, qui non seulement améliore l'enseignement technique en Algérie, mais soutient également les objectifs nationaux de développement économique, de souveraineté numérique et de formation du capital humain. L'académie numérique proposée représente une étape fondamentale vers une société algérienne plus connectée, plus compétente et plus autonome numériquement. Les travaux futurs se concentreront sur la mise en œuvre de la plateforme, des tests pilotes auprès d'utilisateurs réels et une amélioration continue basée sur les retours d'expérience et l'évolution des tendances technologiques.

الملخص

في هذا العالم الرقمي سريع التغير، شهدت أنظمة التعليم في جميع أنحاء العالم تحولات عميقة، لا سيما استجابةً لجائحة كوفيد-19. لم يكشف الوباء عن قيود التجارب التعليمية التقليدية الحضورية فحسب، بل ألقى الضوء أيضًا على الابتكار الشامل والقابل للتطوير في التعلم الرقمي. في ظل هذه الخلفية، تواجه الجزائر (مثل العديد من البلدان النامية الأخرى) تحديات هائلة عند محاولتها توفير تعليم حديث في مجال تكنولوجيا المعلومات يلبي الطلب المتزايد على القوى العاملة الرقمية بشكل متزايد، والمتطلبات التنافسية لسوق العمل العالمية.

تقترح هذه الأطروحة تصميمًا منهجيًا لأكاديمية رقمية تركز على البرمجة والذكاء الاصطناعي وتكنولوجيا المعلومات، وتحديدًا في السياق الجزائري. تهدف المنصة إلى بناء جسر بين التعليم التقليدي والحاجة إلى تدريب تقني عملي وسهل الوصول وعالي الجودة، من خلال تقديم نظام بيئي تعليمي شامل يتكون من نظام إدارة تعلم متقدم (LMS) ومحتوى دورات تفاعلي وتقييم فوري ومشاركة مجتمعية، وكلها مقدمة باللغتين العربية والإنجليزية.

يبدأ البحث بمراجعة الأدبيات التي تسلط الضوء على منصات التعلم الرقمي عالميًا، وفي العالم العربي، وفي الجزائر. ويصف هذا البحث آثار نقاط القوة والضعف والقصور المهمة على محتوى التواجد الإلكتروني، وبنيته، وتجربة المستخدم، وتصميمه التربوي، والتحسينات المحتملة لمواكبة الاحتياجات المتنامية لأسواق العمل. وقد أُجري تحليل للمنصات الأصلية باستخدام تحليلات نوعية وكمية، قدّمت مقارنة مفصلة للأنظمة التعليمية القائمة في الجزائر، والتي تتسم بعدم هيكليتها، وقلة تفاعليتها، وعدم أمان المعاملات المالية، حيث تعتمد جميع العروض التعليمية على روابط الوصول إلى وسائل التواصل الاجتماعي (فيسبوك، يوتيوب) أو مواد التعلم الإلكتروني (الموارد التعليمية، المراجع، الوثائق).

وبناءً على هذا التحليل، أُجري تحليل دقيق للمتطلبات، لوضع مجموعة من المتطلبات والمواصفات الوظيفية وغير الوظيفية، مع تكييف التوصيات بما يتناسب مع الخصوصيات الاجتماعية والتقنية للسياق الجزائري. وشملت هذه التوصيات محدودية الوصول إلى البنية التحتية، لا سيما في المناطق الريفية، والتنوع اللغوي والثقافي، بما في ذلك اللغتان العربية والأمازيغية، ومواءمة تصميم المناهج مع الاستراتيجية الوطنية للتحول الرقمي، واستراتيجية تشغيل الشباب.

تُمثل المنصة والبنية التحتية خيارات تصميم موجزة وجيدة لإنشاء نموذج تطوير معياري وقابل للتوسع، والذي تمت مناقشته في مراجعة الأدبيات باستخدام نموذج التطوير Waterfall. يشمل ذلك نظام إدارة التعلم متعدد الميزات غير المقيد، ونظام دفع المعاملات عبر الإنترنت الحالي؛ ودورات تعليمية عبر الإنترنت والرعاية المنزلية؛ ولوحات التقدم ووظائف التتبع؛ ومجموعة متنوعة من الميزات التعاونية، مثل منتديات النقاش والدردشة المباشرة، وتطوير أنواع متعددة من الدورات التدريبية في البرمجة والذكاء الاصطناعي. كما تم حل قضايا أخرى مثل الوصول إلى نظام إدارة

التعلم؛ والوصول إلى بيئات متعددة اللغات؛ والوصول المتوافق مع الأجهزة المحمولة؛ وضمان الشمولية وسهولة الوصول لمجموعة من المستخدمين.

في نهاية المطاف، تدعو هذه الأطروحة إلى نموذج تعليم رقمي مستدام ومناسب محليًا، لا يُعزز التعليم التقني في الجزائر فحسب، بل يدعم أيضًا الأهداف الوطنية في التنمية الاقتصادية، والسيادة الرقمية، وتكوين رأس المال البشري. تُمثل الأكاديمية الرقمية المقترحة خطوة أساسية نحو مجتمع جزائري أكثر ترابطًا ومهارة وتمكينًا رقميًا. سيركز العمل المستقبلي على تنفيذ المنصة، والاختبار التجريبي مع مستخدمين حقيقيين، والتحسين المستمر بناءً على الملاحظات والاتجاهات التكنولوجية المتطورة.

Keywords: digital education, e-learning platform, IT training, programming, Algeria, requirements analysis, digital transformation, software architecture.

Contents

List of Figures

List of Tables

General Introduction

1. Context and problematics and solution

In the last few years, particularly since the COVID-19 pandemic in 2019, a remarkable digital transformation has taken place across all sectors in the world. Education has gone through a considerable shift towards remote and an online way of distributing knowledge. Education institutions around the globe had to shift their delivery mode to distance delivery for a host of reasons, which led to the rapid adoption of digital platforms for education, including, but not limited to Moodle, Coursera, and others. In a time of crisis, these platforms became the tools to keep education running and remain a part of most educational ecosystems today.

This global shift changed how we distribute and consume knowledge and has resulted in a major longing for technical and digital skills. IT (information technology) and programming are now key components in building digital societies and a knowledge-based economy. Many global platforms for education focusing on IT and programming education now exist. Examples of a small number of global platforms for IT and programming education audiences focus on Arabic are Barmej, Edraak, and Sattar while global platforms include Udemy and Cisco Networking Academy.

With Algeria's national strategy on digital learning and bolstering a culture of the development of technical skills, the lack of locally available, quality, and professional platforms in ICT education is a significant void. C Lspecifically, the interest in the fields of programming, AI, and digital technologies is growing, for the most part, the learning opportunities in Algeria are traditional setups using a lot of in person, print and limited digital. While there was some movement into providing online courses from some institutes and training institutions, they are usually provided on informal delivery methods using social media messaging options like Facebook or Telegram. The delivery currently has drawbacks that include:

No secure Payments: You do not have many current platforms that provide integrated and secure online payment options, so there is a risk for both institutions and learners.

Unstructured education: The gaps in the defined curriculum, learners tracking, options for education structures makes it difficult to have consistency around outcomes.

Low success rates of courses: The problem with social media is that learners are focused attention is being disrupted by the media that is used with less specific learning outcomes and increased distractions, which reduces course completion rates.

In an attempt to tackle these issues and bridge this important gap in Algeria’s educational infrastructure, we propose the design and development of a complete digital academy - a fully Algerian platform for IT socials and learning, programming education, and artificial intelligence. It will be a different type of educational and administrative ecosystem that matches the pedagogical quality of an international competitor while better serving our local populations.

The proposed digital academy will encompass the following aspects:

1. High quality and technical content: High quality and technical provided by qualified professors with a professionally designed academy platform across contemporary IT fields including web development, Ai, data science, cybersecurity, etc.

2. Full Learning Management System (LMS): A full LMS to manage courses, track student engagement, scheduling learning sessions, and provide students with certification with artefact of learning.

3. Interactive learning opportunities: Learning opportunities such as live coding challenges, automated assessments and quizzes to gain student engagement in learning.

4. Community and support: Niche community engagement support from forums and community threads, and availability of technical support for peer to peer collaborative learning and addressing learners' issues was they progress through the learning objectives.

5. Architecture and security: This design will ensure secure payment options for students and high performance and standards for the growing number of users and members in a scalable environment.

Through this project, we want to help to revamp this learning experience in Algeria but also partake in making our national contribution towards developing a new generation of professionals in development and IT. One that will stimulate Algeria's digital move forward.

2. Objective of the platform

The platform aims to provide a secure, integrated learning environment with high-quality content delivered by qualified instructors, fostering technical competencies and training professional developers, as it aims to

- Promoting digital learning in Algeria: Providing a world-class Algerian platform that supports distance learning in coding and artificial intelligence.
- Developing technical skills: Delivering high-quality educational content by qualified professors to train professional developers and build a skilled technical workforce.
- Supporting innovation and building a technical community: Creating a space for students and developers to exchange ideas, share experiences, and foster creativity in technical projects.
- Encouraging continuous learning and professional development: Offering up-to-date content aligned with technological advancements, along with accredited certificates to enhance employability.
- Providing an integrated learning environment: Featuring a learning management system (LMS), interactive tools like self-assessment quizzes and live coding exercises, discussion forums, and dedicated technical support.

Through this academy, we aim to bridge the digital divide in the field of digital education in Algeria and create a new generation of programmers.

CHAPTER 1

Literature Review

1. Introduction

This chapter examines key literature with respect to designing digital educational platforms developed for IT, programming and artificial intelligence in Algeria. This chapter will discuss:

Concepts of Online Learning: Definitions, types of platforms, and features of content.

Educational Platforms in IT: A review of platforms worldwide, Arabisation, local platforms.

Job Market Needs in Algeria: Employment needs for technical skills, and the issues with technical education.

The overall aim is to develop a body of knowledge to develop a platform that is specific to Algeria, both in terms of its education system and working environment.

1.1 Importance of the Study

This study derives its importance from the growing need to modernize and develop Algerian digital education, in the field of information technology, programming and artificial intelligence, and the study also aims to find innovative solutions based on modern technologies to fill the gap of specialized technical competencies in the labor market and provide high-quality educational opportunities for Algerian youth and contribute to building the knowledge economy in Algeria.

1.2 Objectives of the Literature Review

a. Define the basic concepts, types and characteristics of digital education.
b. Present, analyze and evaluate current digital platforms.
c. Identify the challenges facing digital learning in Algeria.
d. Identify the best solutions, technologies and the latest techniques in digital learning.

2. Theoretical Framework for Digital Education

2.1 Define digital education and its basic concepts

A learning and training method that adapts to the increasing needs of the information society, digital education aims to improve the use of innovation and technology while developing digital skills that can be applied to the educational ecosystem. The use of digital technologies to improve and streamline instruction is known as digital education.

It is a logical consequence of the development of information and communication technologies (ICT) and the societal impacts they have caused. As such, it is not only focused on developing tools for distant learning and interaction, but also on the fundamental reorganization of education.

Promoting ICT integration at all educational and training levels, including the human resources component of the sectors concerned, is imperative in light of this reality. [1]

An educational software and information system used by corporations, colleges, and universities to train students and centrally store learning resources is known as an e-learning platform. E-learning systems are not required to offer any particular functionality, though.

Some people consider e-learning platforms to be similar to content management systems, while others consider them to be learning management systems, computer-

supported collaborative learning systems, or virtual communities of professors, teachers, and students who employ knowledge management techniques. [2]

Digital learning is based on only several main principles, including:

Adaptability defined as the flexibility to learn at any time and from any place, according to the individual student's needs and schedules. As well as interacting using interactive digital resources (such as virtual reality, educational games, and tests) to encourage the successful participation of students. Another principle is accessibility, which is to ensure that all online learners, regardless of their location or financial situation, have access to educational materials.In addition to this, personalization means providing a customized learning environment that suits the requirements and level of understanding of each student, with the ability to monitor progress and provide personalized assistance .

Modern technologies play an important role in this learning process, as the principle of integrating advanced technology such as the use of cloud computing, virtual and augmented reality, and artificial intelligence to enhance education and the educational process. Learning outcomes are also enhanced by carefully monitoring students' progress and providing immediate assistance to raise their academic standing, which makes this principle also play a role in the quality learning process.
The educational process seeks to reduce disparities in education, that is, reduce economic and geographical disparities by giving children in deprived or rural places fair opportunities to obtain education .

There is also an important principle that results from the previous principles mentioned, which is encouraging life and digital skills, as it develops students' abilities to think critically, cooperate, manage time, and solve problems while preparing them for the requirements of the digital labor market.

The educational process also depends on the principle of data-driven learning, which is the use of learning data analysis tools to identify students' strengths and weaknesses and allocate support to them.
Also cooperate with the private sector such as technology companies to provide innovative educational solutions, interactive content and teacher training. [3]
These were the most important principles of digital education.

2.2 An overview of the evolution of digital education

The advancement of digital learning has occurred in a sequence of stages over the years, each marked by notable changes due to technological development. The following provides an outline of the primary milestones in the evolution of digital education:

Each stage of the evolution of digital education has been impacted by shifts in educational theories and technological advancements. The foundation for the use of technology in education was laid at the start of the twentieth century when traditional educational tools like television, educational movies, and radio were employed to raise the standard and level of interaction of instruction.

With the rise of Computer-Assisted Instruction (CAI) in the 1950s and 1960s, universities began using mainframe computers to deliver focused educational programs

that enable learning to be tailored to each student's level. The theory of educational constructivism developed as a result of the arguments between various pedagogical trends. Some embraced the computer-controlled programmed learning model, while others, like Seymour Papert, advocated for empowering students to act as creators and programmers in the classroom.

With the growth of the Internet in the 1990s, educational content could now be distributed through the World Wide Web, and digital educational platforms with a variety of multimedia content started to appear. The use of these platforms increased significantly in the first ten years of the new millennium, as educational initiatives like Lynda and Khan Academy drew a sizable student body.

In 2012, the advent of Massive Open Online Courses, or MOOCs, revolutionized the education of the world by making it accessible to millions students globally. There are concerns on course completion rates and learning effectiveness in the use of MOOCs. The primitive academic institutions slow embrace of the technology coupled with the introduction of certified online programs made it easier to integrate digital learning into the formal education system. Nevertheless ensuring high quality digital training for all demographics, and providing the technology to all students remained problematic.

The COVID-19 pandemic in 2020 caused a significant shift, forcing most educational institutions to fully adapt to digital instruction. As a result, the use of digital platforms rose considerably, but it also brought to light key difficulties such as insufficient infrastructure, privacy concerns, and the difficulty of rapidly generating compelling digital learning tools.

Although traditional classroom instruction is increasingly making a comeback, there is still much debate over the future of digital education. However, current advances in artificial intelligence and virtual reality technologies indicate that digital education will remain critical to the global educational scene, with significant potential to improve access and quality. [4]

- We will simplify the stages in the following table

***Table 1**:Simplifying the evolution of digital learning.*

Year/period	Event / Main Phase
The beginning of the twentieth century	Use traditional teaching aids: TV, educational movies, radio to improve the quality and interactivity of learning
1950-1960	The emergence of Computer Assisted Instruction (CAI) using mainframes to individualize education
1990	The proliferation of the Internet and the emergence of multimedia digital learning platforms

2012	The rise of MOOCs (Massive Open Online Courses) and the provision of education to millions of students.
2010-2020	Traditional universities embrace digital education and accredited online education programs.
2020	COVID-19 pandemic and the complete transformation of digital education with infrastructure and privacy challenges.
2025 (Future)	Digital education continues to evolve with the integration of AI and VR technologies to improve the quality and accessibility of education.

- This design illustrates the evolution of digital education with simplicity and clarity of vision.

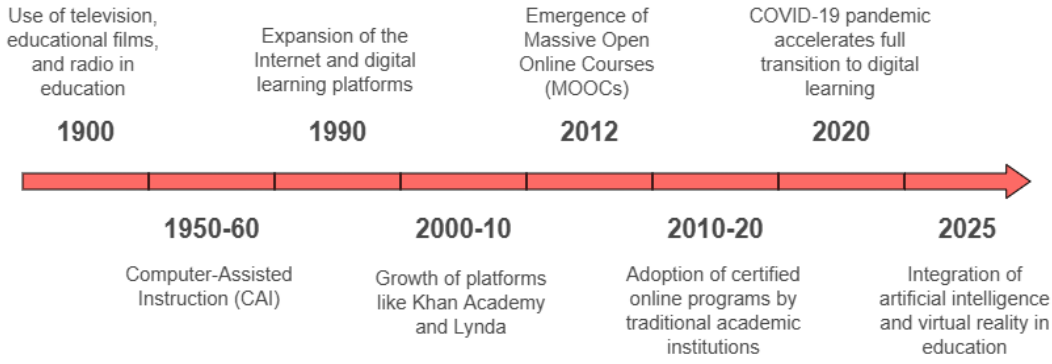

***Figure 1**:Timeline illustrating the key milestones in the evolution of digital education from 1900 to 2025.*

2.3 Types of digital learning platforms

2.3.1 Learning Destination Sites

A shared website that provides courses from numerous providers is known as a learning destination site. Consider this a storefront, similar to how many retailers use Amazon as their front end.
Learning destination websites usually let you create your courses with a learning management system or authoring tool, then upload or connect the courses to the website. The websites often take care of eCommerce and learner registration for you. Common websites are edX, Skillshare, Coursera, and Udemy. Numerous sectors also have their own specialized websites. [5]

2.3.2 Commercial Learning Management System

A platform that offers the fundamental features required for creating and hosting online courses is known as a commercial learning management system. It includes basic features required for online courses, including the ability for course designers to create, save, and administer learning profiles, as well as to report grades and progress.
Among the hundreds of learning management system providers available on the market, the majority focus on internal training for corporate learning and development. Some do, however, provide more extensive enterprise features that facilitate content repurposing for outside audiences. [5]

2.3.3 Learning Experience Platforms (LXPs)

A new generation of learning management solutions arose in response to the well-documented dissatisfaction that users frequently experience with conventional solutions. These businesses prioritize the learning experience and occasionally particular pedagogies that aren't well supported by conventional LMS solutions. There is a growing overlap between commercial LMS solutions and LXPs. Businesses such as Docebo, Totara, Litmos, 360Learning, and NovoEd are examples of vendors in this category. There are many more, and the terrain is always changing, so it would be unjust to mention just these. [5]

2.3.4 Open Source Learning Management System

Similar to the commercial LMS solution, an open source learning management system is a platform that offers the fundamental features required for creating and hosting an online course.
The distinction is that they can be customized and are usuallyfree.For a charge, communities of vendors typically exist for each platform that can host, configure, and personalize open source learning management systems. Sakai, Open edX, and Moodle are popular open source learning platforms. [5]

2.3.5 Hybrid Learning Platforms

The learning management ecosystem is another kind of online learning platform. Using this concept, businesses aim to integrate best-of-breed "point" solutions into a single platform. To mention a few characteristics, learning content management systems, engines, tools, ecommerce websites, and course authoring software are all combined and offered to the student as a single solution.

To give the appearance of a single system, they are frequently constructed with a unique front end. Open edX, an open source learning management system, is at the heart of the University of Notre Dame's NeXus platform, which serves as an illustration of a learning management ecosystem. The platform includes a unique front interface and combines over a dozen different software products. [5]

2.3.6 Custom Built Learning Platform

The fully custom-built learning platform comes last among online learning systems. By concentrating on the needs of the company, the learner, and the pedagogy, this solution allows you to create all or the majority of the technology you require from scratch.

You receive precisely what you need and have total control over the experience and direction with this solution, which also takes the longest and is frequently the most costly. HBX, a platform designed just for Harvard Business School to offer extremely expensive business degree courses, is a prime example of a fully customized learning environment. [5]

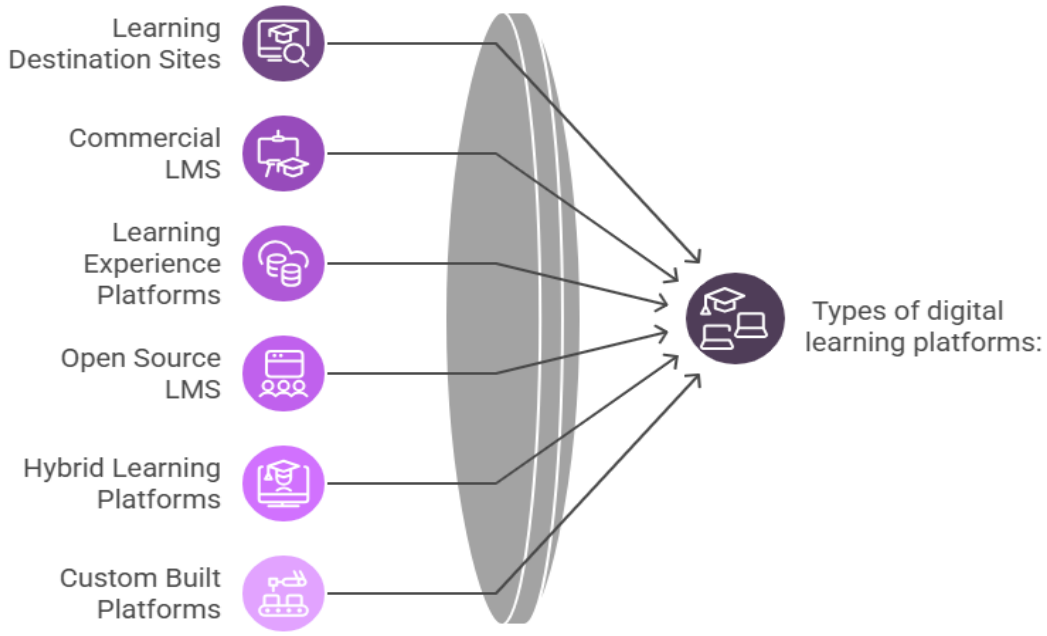

***Figure 2**:Types of digital learning platforms.*

- **Point of view**

The effectiveness of digital learning platforms is affected by their advantages and limitations. For instance, learning destination sites enable easy navigation and open access to a variety of content, but they do not offer personalization or interaction from the lecturer's end [5]Commercial Learning Management Systems (LMS) have reliable systems with technical support, but might be inflexible to the needs of heterogeneous educational institutions. On the opposite side, Learning Experience Platforms have increased engagement, but their complexity in integration and high

cost hinders wide adoption. Moreover, open source systems provide great versatility at little cost; however, the technical skills needed to administer them might restrict their use in some organizations. Finally, proprietary systems offer the most customization, but are limited to large, well-funded organizations due to substantial expenses and time needed for development.

2.4 Advantages of digital education

Personalised learning: Personalized learning adjusts instruction to meet each student's unique needs. This can apply to delivery, content, and tempo. It acknowledges that when it comes to education, there is rarely a one-size-fits-all solution. Students will, after all, learn differently and at varying rates. Their demands will differ, and they will react differently to oral, written, and visual information.
For individualized learning experiences, a virtual learning environment is the perfect setting. As per a research conducted by the Bill & Melinda Gates Foundation, "vast majorities" of educators think that digital tools and data are "improving teaching through differentiation and personalization."
Each student pursues their own learning path in a setting created by a contemporary learning platform. For instance, extra resources can be activated to assist students in backfilling their knowledge if they are having trouble with a particular subject. A different student who is already proficient in that area might not require more material; instead, they might need to spend more time on another aspect of the course. By tailoring instruction to each student's unique needs, teachers can achieve the greatest outcomes. [6]

Gamification: Gamification uses well-known paradigms for technology users to create more effective and captivating learning experiences. Incorporating user-friendly digital technologies, which many students will be accustomed to from gaming, into course design can inspire students with instant feedback and rewards. Education can employ a variety of strategies by utilizing the gaming model's tenets. These consist of badges and points being given out. After all, pupils will consistently achieve; praising and rewarding them encourages them to keep going. When students perceive a clear path through their learning process and are recognized for achieving significant milestones, they have something to strive for.
Successful test scores aren't the only learning behaviors that games-based learning can reward; it can also recognize positive learning behaviors like taking part in conversations and conducting independent research. [6]

Self-directed learning: Students will need to develop their ability to learn on their own as they move through the educational system. This speaks to the ability of students to take charge of their education, manage their own time, and conduct independent research. They will learn more about when and how they learn best along the process. In order to make the most of their study time, this will assist them in creating tactics for making the most of it. That could mean learning in the morning for some people and later in the day for others.
Important life and work skills include the ability to take charge of an activity, schedule time to complete it, and achieve the greatest results.
Students who learn time management and planning skills will benefit in the workplace.

The perfect framework for every student's educational path is offered by a digital learning platform. Students can plan their course of action, view the breadth of their obligations throughout time, and access their course schedules there. [6]

Easier to access: Students who might otherwise find it difficult to obtain education now have a means of learning thanks to online learning. Being able to learn remotely is helpful in rural areas where there may be inadequate travel infrastructure. Students who have other obligations, like jobs, children, and other caregiving commitments, will also value solutions that allow them to balance their studies with their hectic schedules.
Since not everyone can study at the same time or from the same place, education must be accessible to all. No matter where they are in the world, students and tutors can connect through digital education. Even when students are unable to visit the college, institution, or other learning location, the materials in the learning platform give them access to all the education they require.
With online learning environments offering discussion boards, tutorials, and feedback, students may still engage and collaborate at high levels whether their education is entirely online or a combination of digital and in-person instruction. [6]

Students can learn at their own pace: Students can learn at their own speed with digital education, which also allows them to access learning at any time and from any location. They can review previous modules or reread content to obtain a deeper understanding of a subject.
Students get round-the-clock access to a variety of resources through the learning platform, including lectures that have been recorded and can be seen again. When a lecture concludes, the content is retained rather than lost.
In order to maximize successful learning outcomes, maintain student motivation and engagement, and prevent a "edtech reality gap," self-directed learning which is done at the student's own pace gives students ownership over their own experience [6].

Digital assessment tracks progress: Students will probably be evaluated several times as they advance in their education. Digital evaluation does not have to be limited to assessing paper assignments; it can also involve pre-recorded presentations or live internet sessions.
Students can record themselves performing a practical job or listen to audio files that explain how to pronounce a modern foreign language. West Bridgford School (WBS) in Nottingham, England, successfully implemented this. Through the use of Brightspace's Video Assignments tool, WBS allowed students to record themselves cooking while explaining their actions in the language they were studying.
Digital evaluation gives educators the ability to precisely target feedback to a particular section of an assignment. In addition to being text-based, video entries may also be time-stamped. Feedback can also include tags to course material so that students can directly connect to subjects they might need to review. [6]
Time-saving features in digital assessments make feedback and grading easier and more efficient, relieving tutors of tedious marking. Tutors can then devote their time to discussing learning aspects. The ability to automatically mark quizzes with both right and wrong answers can save teachers a ton of time.
The online learning platform gives students easy access to their grades and feedback throughout time. In this manner, individuals are able to see their progress clearly and go back and review the feedback whenever necessary. [6]

Blended learning : Online education and some in-person tutoring are combined in blended learning. Because it blends the flexibility and ease of online learning with the individualized attention of in-person instruction, this strategy has the potential to be incredibly effective.
Depending on the kind of course and the needs of the students, every school and teacher will have a different approach to blended learning. Many believe that blended learning makes it possible to implement a "flipped" classroom strategy, where students use the learning platform to access knowledge in order to get ready for in-person instruction. Thus, while knowledge application takes place in the classroom, knowledge acquisition takes place outside of it, possibly from lectures that have been recorded, documents, videos, and other resources. [6]

Competency-based learning: Competency-based learning acknowledges that students will advance at varying rates over the course of a given study time. Some subjects will require more time from the students than others. To fill up knowledge gaps, they might also need to add extra information to the core course material. Because digital education is adaptable and allows for customized learning paths within a framework built on reaching predetermined goals, it makes competency-based learning possible. The learning platform's built-in logic allows students to move from one subject to the next only once they have mastered it and fulfilled predetermined requirements. [6]

Collaborative learning: A large portion of today's students are already accustomed to sharing stuff on the internet. They are accustomed to collaborative online environments since they use social media platforms.
Both student-to-student and tutor-to-student interactions are not necessary for digital education. In order to learn from one another, students can share their work with the tutor and with each other. Additionally, they can use chat rooms, video conferencing, and document sharing facilities to collaborate on group projects. Social and teamwork abilities are developed through this kind of cooperation.
Since everyone is just a click away online, students can interact with classmates worldwide, expanding their horizons and forming a variety of relationships. [6]

Improves digital literacy: In the current technological world, everyone needs to be digitally literate. The ability to find and exchange knowledge using technology is known as digital literacy. It's a necessary life skill and a requirement for many occupations. It's likely that technology will be used even throughout the job application process.
Nearly all UK children between the ages of 5 and 15 (97%) used the internet in 2020, and more than half of them reported posting or uploading content on video-sharing websites, according to Ofcom. However, according to the same survey, 82% of children aged 3-4 went online in 2020, and 48% already had a tablet, indicating that children's first experiences with technology now precede school.
Students that receive digital education are more equipped to use technology and make the most of it. Finding, accessing, consuming, and sharing content online becomes second nature to students enrolled in digital education programs. They learn to be selective about the information they consume, judging what is reliable, secure, and supported by facts. [6]

- **Note:** The flexibility provided by the internet allows for learning to take place completely online or through a blended approach which uses traditional methods alongside digital resources. The convenience brought by information technology motivates students to appropriately participate in the learning activities. In addition, learners are proving to possess critical digital competencies that transform possibilities in other respects including personally and professionally. At the same time, his communication can be enhanced by the use of digital learning platforms which enable the student and teacher to interact at any appropriate time. Educational data is able to capture information regarding the student's academic performance which in turn enables development in the quality of education offered. As a result, if you are initiating or advancing your journey in technology enhanced learning, these platforms should be understood in regard to how they can be utilized to improve the entire education process.

3. Digital learning platforms in the field of IT and programming

3.1 Analysis of Leading Global Digital Learning Platforms

Coursera

Coursera is an online learning platform that offers a wide range of disciplines in a variety of learning forms, including tutorials, professional certificates, degrees, courses, and specializations. Coursera offers education from more than 300 top colleges and businesses, including Google, IBM, Microsoft, Stanford, Duke, Illinois, and the University of Colorado Boulder.
Coursera offers a wide range of possibilities, whether your goal is to learn something for pleasure, improve an existing skill, or advance your education with a formal credential like a Professional Certificate or degree.
You can access course materials and information at your own speed because a large portion of the learning that occurs on Coursera is asynchronous. In this manner, you may fit your education around your other obligations and into your schedule. Coursera stresses high-quality learning by using online teaching and learning methodologies that are supported by research. 73 percent of students who finish courses on the Coursera platform report good career-related results, and the site's courses have an average rating of 4.7 out of 5 stars. Our research report, Drivers of Quality in Online Learning, contains further information about our data and methodology.

What is a Coursera certificate?
Credentials known as Coursera certificates attest to your successful completion of a program or course. These are secure URLs that are kept on your Coursera account's Accomplishments page. You can download them as a PDF file to print, share them online, or upload them to your LinkedIn profile. The name of the course, the instructor's signature, and the logo of any associated partner university are all included on each Coursera certificate. Along with a verification URL you may provide to employers or anybody else who might wish to confirm the legitimacy of your certificate, you will also receive confirmation that Coursera has validated your identity. [7]

Udemy

By providing a wide range of courses on almost any subject imaginable, the online learning platform Demy has completely changed the face of education. Students from all backgrounds can access top-notch instructional materials on Udemy at their own convenience and leisure. Since its founding in 2010, Udemy has expanded to become one of the world's biggest online learning environments, with thousands of teachers and millions of users. Udemy offers a multitude of materials to support your learning journey, whether your goals are to explore a hobby, advance your profession, or perfect a new skill.

A wide variety of courses covering topics including business, technology, personal development, and the creative arts are available on Udemy. There is something on Udemy for everyone, ranging from web development and programming to photography and music creation. With more than 155,000 courses offered in more than 65 languages, students can study subjects according to their interests and professional aspirations. Udemy provides courses for all skill levels, whether you're a novice trying to learn the fundamentals or an expert hoping to expand your knowledge.

Udemy's flexibility and accessibility are what make it so appealing. Students can use a computer, tablet, or smartphone to access course materials at any time and from any location. Because of this flexibility, people may fit learning into their hectic schedules, whether they are traveling overseas, having a vacation at home, or commuting to work. Furthermore, students can move through the content at their own pace using Udemy's self-paced courses, enabling individualized learning experiences catered to each student's requirements and interests. [8]

edX

A company with a clear vision, edX is dedicated to revolutionizing traditional education by eliminating obstacles related to access, cost, and location. In the areas of law, history, physics, engineering, business, social sciences, computer science, public health, and artificial intelligence (AI), edX provides MOOCs and interactive online courses. [9]

3.2 Evaluation of Arabic Digital Learning Platforms

Edraak

An initiative of the Queen Rania Foundation (QRF), Edraak is a massive open online course (MOOC) platform. QRF is committed to putting the Arab world at the forefront of innovative education. In order to harness technology created by the Harvard-MIT cooperation, edX, QRF has leveraged local Arab expertise to establish the first Arabic MOOC platform that is non-profit. The Arab world will have the opportunity to participate in a crucial transformation in education and learning through the new MOOC platform.
In order to further enhance Arab education, the platform will first broadcast the top Arab academics to the area and provide unique Arabic courses created by QRF. The platform's collaboration with edX will also enable Arab students to access Arabic-language courses created and taught by prestigious universities such as MITX, HarvardX, and UC BerkeleyX. The learner is not charged for any of the courses.
Second, by airing brief online courses taught by practitioners and experts from a range of disciplines, including the arts and sciences, QRF hopes to use the platform to highlight Arab role models.
Last but not least, QRF thinks the platform would allow the Arab world to share its own story with the globe and capitalize on the global interest in regional issues. The portal allows regional specialists and professors from Arab universities to teach English-language courses about the region and its history. A worldwide audience interested in the development of the region will be informed by this. [10]

Barmej

Barmej is the first platform that offers interactive videocourses in Arabic. The courses are tailored for users with no or little prior programming experience and focus on practical application. Their aim is to increase programming skills awareness in the Arab world with the hopes of developing a new generation of programmers. Barmej teaches modern programming languages using the most up-to-date technological practices, emphasizing practical comprehension. The platform includes challenges and assessments in the form of short quizzes to test the competencies of the learners. The content is customized to fit the needs of both novices and seasoned professionals and is tailored toward practical skills and solving real-life challenges. Barmej offers learners a rich community to interact and collaborate, enabling shared experience, support towards their programming goals. With Barmej's growing popularity, over 287,000 learners have started to use the platform, which indicates successful learning outcomes from the provided services in the Arab region. [11]

Almdrasa

Almdrasa is an Arabic platform centered on teaching programming to students ranging from beginners to experts. It focuses specifically on teaching Arab learners. The approach of the platform is different as it provides detailed explanations in Arabic done by professionals from global companies such as Google, Microsoft, Amazon, and Meta. Through Almdrasa, learners can enjoy numerous courses, participate in practical projects, and receive mentorship to guarantee that they not only learn but also master the skills needed. The vision of the platform is to train a

new collective of Arab programmers and it caters to the learners of any age, background, preparing them for the competitive global employment opportunities.
Almadrasa uses interactive e-learning methods, which are dependent on modern technologies. It makes the most of today's widespread use of computers and internet to deliver education videos or other materials to students all around the world--and explains with various activities. Lessons are presented in an easy-to-understand way, combining theory with practice. The result is an engrossing educational environment enabling immediate interaction between teachers and their pupils from any location at whatever time. In addition, the platform uses data analytics to produce reports on the situation of your project and obtain marks of the quality of education. [12]

Rwaq

Rwaq is an online learning platform that offers free academic study materials in Arabic for a variety of subjects and specializations. These materials are presented by renowned scholars from across the Arab world who are eager to broaden the audience for their specialized knowledge and scientific resources. They aim to reach people who are not inside the university.
You can enroll in the material that interests you, follow its lectures once a week, and interact with lecturers and classmates wherever you are and at any time. This is true whether you are a university student looking to expand your knowledge in your field of specialization, a busy employee who is interested in cognitive exploration in a specialty, or a person who enjoys learning and expanding knowledge for its own sake. which works for you. Through an arcade, you can receive it all for free. [13]

3.3 Evaluating Algerian digital learning platforms

There are many digital academies in Algeria to teach it, but most of them specialize in booking courses and teaching classically or via Telegram and Google Meet.
We list them:

EduTime

is a web-based program for electronic training and course booking that offers easy-to-use registration processes, a wide range of courses, and the ability to view the reviews of previous students.
Users may efficiently register and quickly get information about various courses.
EduTime is a remarkable contemporary technology that supports training and education in the digital age. It incorporates contemporary marketing, allows for speedy registration, promotes efficient communication, and improves educational results. [14]

DzCode i/o

is a project designed to unite the Algerian IT community around a range of open-source initiatives. It provides a forum for developers to work together, exchange ideas, and support the growth of open-source software in Algeria.

DzCode i/o acts as a gateway for Algerian developers, enabling them to participate in and make contributions to open-source projects that foster regional innovation and cooperation.
By allowing developers to search for and contribute to an ever-growing list of more Algerian open-source projects, it facilitates community engagement.
The platform facilitates close collaboration among Algerian developers, thereby contributing to the growth of Algeria's technological sector.
Generally speaking, DzCode I/o was utilized for remote and cooperative community building through open-source projects (educational initiatives). [15]

GOMYCODE Algeria

One company that teaches digital skills is GOMYCODE Algeria. They provide a number of boot camps and courses aimed at getting people ready for the digital economy. GOMYCODE provides coding boot camps, integrated courses for web development, and more. These are hands-on classes designed for engaged learners who acquire skills as quickly as possible.Given that bootcamps and other courses are offered, the learning system appears to incorporate both some online and offline instruction.

French is the main language of education. French is used in GOMYCODE's Summer Academy in Algeria. Additionally, they offer basic data skills training in Algeria, with a suggestion for French-language education. [16]

Rising Academy DZ

Rising Academy DZ is a respectable school because it offers learning services including test preparation and academic assistance.
A curriculum centered on the educational support offered at Rising Academy DZ is presented. It seems that improving students' academic performance and helping them pass pertinent tests is their main goal.
The in-person tutoring provided in addition to the other educational program components gives the impression that this institution uses a learning system that incorporates a number of distinct teaching techniques. It is anticipated that designated review sessions will come after particular instructional times. Furthermore, it is presumed that some formative assessment will take place through practice tests.
It is a Facebook page that offers courses via Google Mate and they do not have a platform on the web.This is what I searched for. [17]

- **Note**

  I found most of the other integrated Algerian platforms on the web not only specialized in it, but also diverse in specializations and fields.There are also those that focus on educational stages, such as providing support lessons for the middle and secondary years.

3.4 Comparative Analysis of Digital Learning Platforms

The following table provides a comparative and in-depth analysis of international, Arab and Algerian platforms :

***Table 2**:Comparative Analysis of Digital Learning Platforms.*

Platform	Key Features	Cost Structure	Ease of Use	Content Quality	Language(s)
Coursera	University partnerships, degrees, certificates, flexible pacing, verified credentials	Freemium (free & paid)	High (user-friendly)	Very high (accredited, peer-reviewed)	English, others
Udemy	Massive course variety, self-paced, lifetime access, instructor diversity	Paid (inexpensive)	High	Varies (user-rated, broad)	English, many
edX	University-level MOOCs, professional certificates, global partners	Freemium (free & paid)	High	Very high (university-backed)	English, others
Edraak	Arabic MOOCs, regional experts, free access, partnerships with edX	Free	High	High (curated, academic)	Arabic, some English
Barmej	Interactive coding courses, quizzes, community, Arabic-first	Free	High	High (practical, up-to-date)	Arabic

Almdrasa	Programming, mentorship, industry experts, interactive, analytics	Free	High	High (expert-led, academic)	Arabic
Rwaq	Academic courses in Arabic, open access, weekly lectures	Free	High	High (expert-led, academic)	Arabic
EduTime	Course booking, reviews, digital marketing integration, local focus	Free/paid (varies)	High	Medium (varied, practical)	Arabic
DzCode i/o	Open-source community, project collaboration, IT focus	Free	Medium	High (community-driven, open-source)	English, Arabic
GOMYCODE Algeria	Coding bootcamps, blended learning, professional skills, job focus	Paid	High	High (project-based, industry)	French, Arabic
Rising Academy DZ	Academic support, tutoring, exam prep, Facebook-based delivery	Free/paid (varies)	Medium (platform-limited)	Medium (tutoring, informal)	Arabic, French

3.5 Identify gaps in existing digital educational content

Insufficient Digital Literacy and Ignorance of Proper Training: A majority of teachers receive little to no training on how to use digital platforms. This extends not just to basic pedagogy, but to supervising students in using the internet as well.

Networking Obstacles: One of the biggest challenges is the poor connectivity of the internet, along with the restricted availability of devices. A lot of both students and teachers might not have access to proper internet or any devices at home.

Shortage of Resources and Interactive Content: More engaging learning content is a necessity nowadays. The digital content that is available often does not meet the standards to capture the interest of students, which restricts active engagement within the classroom.

Modification of Curriculum: There is an urgent need to revise curricula and include relevant information pertaining to digitization along with its emerging trends. Adaption of the curricula is required for the unprecedented growth in digitized information and the increasing supply of education aimed at meeting the set standards in this area.

Absence of Resource Sharing: The lack of collaborative use of new technologies at the higher education sector is astonishing, which greatly hampers national, regional, and international relations.

Independence of Learners: Learners often find the self-discipline needed for distance learning rather challenging. To complete an online course, a good degree of self-governance is essential.

3.6 Strengths and weaknesses of local platforms

Table 3:*Strengths and weaknesses of local platforms .*

Platform	Strengths	Weaknesses
EduTime	Efficient registration, diverse course offerings.	Limited focus on interactive content, no clear pedagogical framework.
DzCode i/o	Fosters community collaboration, promotes open-source contributions.	Limited accessibility for non-tech users, lacks structured educational content.
GOMYCODE	Practical skills development, scalable model.	Limited geographical reach within Algeria, high cost compared to local options.
Rising Academy	Personalized support, exam preparation.	Limited focus on digital skills, traditional teaching methods.

➢ **Critique and Recommendations**

- Digital Skills and Training: Most of the platforms do not offer sufficient training for a teacher on how to use a certain digital tool and resource. This deficiency constrains applying technology into teaching processes.
- Development of Infrastructure: Poor connections and a limited set of devices slow down the effectiveness of online platforms. There is a gap that needs to be solved regarding the development of infrastructure to plug gaps in access for everyone universally.
- User Engagement: There is a gap in the fun and interesting digital content available that actively supports students' participation and improves information retention during the lesson.
- Changing the Syllabus: The syllabus has to be revised to include current digital competencies, skills and emerging skills to ensure relevance to today's economy.
- Improvement Through Innovation: The sharing of resource materials and collaboration among institutions should be encouraged to enhance educational outcome and promote innovative approaches.
- Self Discipline: A great level of learner self discipline is required in online platforms. Success in self-paced environments can be achieved by providing supportive structures that can ease some of the burdens.

3.7 A more in-depth critical assessment of the strengths and weaknesses of current digital learning platforms

Table 4*:A more in-depth critical assessment of the strengths and weaknesses of current digital learning platforms.*

Aspect	Critical Analysis
Digital Skills and Training	Most platforms don't provide enough training programs to teach educators how to effectively use digital tools and resources. This flaw significantly limits the use of technology in teaching processes and the educational potential of digital platforms. Teachers struggle to make the most of these resources without comprehensive professional development, which negatively impacts student learning outcomes.
Infrastructure Development	Limited access to digital devices and poor internet connectivity continue to be significant barriers, particularly in underprivileged and rural areas. A digital divide is produced by this infrastructure disparity, which limits fair access to online learning and reduces the overall efficacy of digital platforms. To close this gap, investments in dependable broadband and reasonably priced devices are essential.

User Engagement	The current digital content often lacks interactivity and engagement, resulting in reduced student participation and lower information retention. Platforms need to develop more dynamic, multimedia-rich, and culturally relevant content that supports active learning and motivates learners to engage consistently.
Curriculum Updating	Traditional curricula frequently fail to incorporate essential digital competencies and emerging technological skills, rendering the content less relevant to the demands of the modern digital economy. There is an urgent need to revise and modernize curricula to include critical 21st-century skills such as digital literacy, problem-solving, and digital ethics.
Innovation and Collaboration	The absence of a culture of resource sharing and institutional collaboration limits opportunities for innovation and quality improvement in digital education. Encouraging partnerships and open access to educational resources can enhance content quality, reduce duplication of efforts, and foster innovative pedagogical approaches.
Learner Self-Discipline	Online learning demands a high level of self-regulation and discipline, which many learners find challenging. This often results in low course completion rates and diminished educational outcomes. Providing supportive structures, such as mentoring, progress tracking, and motivational tools, is essential to help learners succeed in self-paced environments.

4. Strengthening Theoretical Framework: Linking Digital Education with Learning Theories

Digital education broadens its horizons in relation to three types of learning theories: behaviorism, constructivism, and connectivism. In the design of digital courses, behaviorism is articulated through imposing measurable learning objectives, providing feedback and assessments electronically, and administering formative evaluations. As a result, these strategies encourage sufficiency and reward through learning, enhanced knowledge building, and the incremental mastery of skills [18]

In constructivism, acquiring knowledge is viewed as semi-active because learners integrate pieces of knowledge from their environment and prior encounters around them. This description, in regard to digital teaching, translates to fostering self-guided exploration and problem solving. It is this type of learning supported by a wide range of resources in the form of highly interactive instruments and learner-centered group activities like activities, simulations, forums, and other proactive initiatives that enable joint understanding construction. [18]

The more recent theory of Connectivism ties seamlessly with the digital era. It considers learning to be the process of forming connections within identities, digital resources, and technology networks; knowledge is dispersed rather than stored in an individual's mind. Learning is achieved by navigating and linking nodes. This theory emphasizes the role of unbounded learning environments, digital collaboration spaces, and MOOCs (Massive Open Online Courses) where the teaching role transforms to that of a guide or facilitator while students actively explore and build knowledge through faceless interfaces and myriad interactions. Connectivism is useful in explaining the socio-technological aspects of learning, which makes it relevant today. [18]

With these three theories, a solid basis is provided for the understanding of digital education. Behaviorism advocates for the control of the learning process and evaluation of the learner, while constructivism supports active participation in knowledge construction. The third theory, that is Connectivism, recognizes the modern context of learning placed in systems and networks.

4.1 Linking Digital Platform Features to Educational Outcomes

Table 5*:Linking Digital Platform Features to Educational Outcomes.*

Feature	Related Learning Theory	Impact on Learning Outcomes
Networked Learning & Collaboration	Connectivism	Enhances social learning, critical thinking, and adaptability by enabling access to diverse information sources.
Interactive Multimedia Content	Constructivism	Promotes active engagement, deeper understanding, and development of problem-solving skills.

Immediate Feedback & Reinforcement	Behaviorism	Supports retention and mastery through practice and corrective feedback, increasing learner motivation.
Personalized Learning Paths	Connectivism & Constructivism	Facilitates learner autonomy and self-regulation by allowing customized navigation of content.
Online Learning Communities	Connectivism	Builds continuous knowledge networks that support peer learning and ongoing professional development.

5. Assessing the needs of the Algerian labor market in the field of information technology

Enhanced technology initiatives in Algeria have enhanced the training and job opportunities. The government investment in digital infrastructure improvement aids in establishing modern job opportunities such as the Huawei ICT Job Fair. Algeria is also making advancements in smartphone usage along with high speed internet services which boosts the economy. This in turn increases the need for experts in various sectors of information technology like software engineering, network management, security analysis, and IT data analysis. All these domains need college fresh graduates with up to date technical skills relevant to today's needs. [19]

5.1 Analysis of the Demand for Technical Skills in Algeria

The labor market in Algeria is witnessing a surge in the demand for skilled technical personnel due to the ongoing digitization of both the private and public sectors. According to OnlyOffice (2025), the most in-demand IT skills in 2025 will encompass the formulation and execution of digital strategies, governance of IT resources, organizational change facilitation, and project oversight. Professional designations, such as Certified Information Technology Manager (CITM) and Project Management Professional (PMP), are increasingly appreciated, indicating that higher-level management and IT leadership needs are growing in sophistication. [20]

In addition, TawdifDZ (2024) reports that more than 60% of new job vacancies in Algeria's IT sector are in programming, application development, and information security areas. This demand will likely increase at a pace of more than 10% per year until 2030. The increase in remote working opportunities and the integration of artificial

intelligence into everyday life are also contributory factors in the enhancement of skill requirements in data analytics, cybersecurity, and software engineering. [21]

5.2 Classification of Labor Market Needs by Technological Sectors in Algeria

Algerian tech labor has greatly been impacted by the increase of remote work as well as the digital revolution. As highlighted in the report on remote work in Algeria, web programming and software development seem to command the attention. Most Algerian remote workers, particularly those employed by external firms, are web developers. This sector is expanding due to the increased digitization of business operations, a surge in new business formation, and the simplicity of remote work. [22]

AI (artificial intelligence) and data analysis are also growing rapidly. There is an increased demand for AI engineers and data analysts. A number of Algerian engineers undertake AI projects for offshore companies. Algeria appears to be adopting the international trend of AI and big data utilization for enhancing organizational decision making. [22]

As more services become digital and remote work becomes commonplace, cyber threats are on the rise, making information security invaluable. Greater experts in cybersecurity, network security engineering, and ethical hacking are required to shift data and digital infrastructure. Companies must comply with international security standards to protect their data safety. [22]

Alongside managing digital infrastructure of a region, network management is of equal importance. With the increased use of high-speed internet and smartphones, network engineers are required to maintain the reliability and stability of internet connections. This is highly important in the context of supporting remote and hybrid work. [22]

Fintech and e-commerce industries are rapidly expanding. There is a need for developers and IT experts who focus on digital payments, blockchain technology, and online shopping websites. These industries aid in the diversification of Algerian economy while integrating it into the global digital economy. [22]

Elaborating from the previous analysis, ongoing advancements in technology have automated processes far and wide, subsequently transforming the Algerian tech employment market. Algeria stands at the forefront within North Africa when it comes to utilizing technology in various sectors such as commerce, education, healthcare, administrative services, and business consulting. Above 60% of tech professionals with remote working privileges are offered positions by foreign firms, which enables Algerian engineers to hone their skills and align with international benchmarks. Yet, it is difficult for local companies to retain senior-level personnel in the face of competitive salaries offered elsewhere and legal complexities surrounding remote work. [22]

***Table 6**:Classification of Labor Market Needs by Technological Sectors in Algeria.*

Sector / Topic	Key Points	Implications / Drivers
Web Programming & Software Development	Majority of Algerian remote workers, especially for foreign companies, are web developers.	Growth driven by business digitization, startup surge, and ease of remote collaboration.
Artificial Intelligence & Data Analysis	Increasing demand for AI engineers and data analysts involved in offshore projects.	Algeria aligns with global trends in AI and big data for better decision-making.
Information Security (Cybersecurity)	Rising need for cybersecurity experts, network security engineers, and ethical hackers.	Due to increased digital services and remote work, companies must meet international security standards.
Network Management & Digital Infrastructure	Network engineers needed to maintain reliable internet connections amid growing internet and smartphone use.	Essential for supporting remote and hybrid work models.

Fintech & E-commerce	Growing demand for developers and IT professionals specializing in digital payments, blockchain, and online retail.	Supports economic diversification and integration into the global digital economy.
Remote Work Culture & WorkforceDevelopment	Over 60% of Algerian tech professionals work remotely, mainly for foreign firms, enhancing skills.	Challenges include local companies struggling to retain senior talent due to salary gaps and legal issues.
Overall Market Impact	Technology advances have automated many processes, transforming the Algerian tech job market.	Algeria leads in North Africa in tech adoption across multiple sectors (commerce, education, healthcare, etc.).

5.3 Evaluation of the Technical Competencies of Algerian Graduates

Even though there is an escalating need for technical competencies, there still exists a considerable gap between Algerian graduates' skills and what the labor market requires. Findings from CERIST (2022) show that about 70% of computer science graduates do not have enough practical experience, which hinders their employment. Underdeveloped industrial and educational infrastructure and inadequate practical training are the main reasons behind this deficiency. Therefore, as reported by the Higher Institute of Science (2024), approximately 25% of graduates from technical education institutes remain unemployed. [23]

At the same time, an increasing number of Algerian students are studying technical fields abroad, especially in Malaysia, where Information Systems Security, Data Analysis, and Artificial Intelligence are in high demand because of good prospects for employment. [24]

6. Analysis of the Challenges Facing digital Education in Algeria

The overall adoption and effectiveness of digital education in Algeria is profoundly challenged by multiple factors. Weak digital infrastructure like slow internet speeds and high costs of accessing the internet, especially in rural and remote areas, is one of the most notable factors restricting both students and teachers from adequately using e-learning systems. [25]

Along with that, there exists a notable gap in qualified human personnel. Many educators do not receive sufficient training to utilize tools of digital education, which deteriorates the quality of interaction and instruction offered on remote platforms. [26]

From a regulatory standpoint, the educational policies in place have been infrequently and poorly synchronized with updates resulting in a lack of alignment with current pace of technological development which stifles the application of fruitful strategies for digital transformation within the schooling system. [27]

In addition, this process meets sociocultural barriers, particularly in areas with flowing educational systems where some students and parents still prefer traditional pedagogies, which sit beside widespread ignorance about the essentiality and mechanisms of digital education [28] [29]

Similarly, the existing concerns of cybersecurity and data protection are increasing requiring more sophisticated policies and techniques for user and information security [25] Besides, as far as the education platforms are concerned, the lack of proper updating and adequate organizing means a more profound lack of specialists which diminishes the quality and uninterrupted accessibility of educational content [26]

The COVID-19 pandemic made remote exams even more challenging and raised concerns about the reliability and caliber of digital tests. It will take time and money to implement technological changes in Algeria's educational system. In order to facilitate online education across the country, significant infrastructure investments are required. To use emerging tools effectively, educators need to undergo extensive, specialized training. To make room for new virtual formats, laws must be changed. Perhaps most importantly, in order to fully realize the potential of digital learning across Algerian communities, a change in perspective is essential. The successful and crucial transition to the new realities of remote education will require consistent, coordinated efforts over many years. [30]

The following table outlines the main challenges and solutions facing digital education in Algeria :

Table 7: *Analysis of the Challenges Facing digital Education in Algeria.*

Challenge	Explanation	Proposed Solutions
Weak Digital Infrastructure	Slow internet speeds and high costs, especially in rural and remote areas, hinder access to platforms	Significant investments to improve digital infrastructure, enhance internet speed, and reduce access costs
Lack of Qualified Human Resources	Insufficient training for educators on using digital education tools, affecting interaction and teaching quality	Specialized and intensive training programs for teachers to develop their skills in using educational technology

Poor Regulatory Updates and Coordination	Educational policies are outdated and poorly aligned with rapid technological developments, limiting effective digital transformation	Update educational laws and policies to align with technological advances, improve coordination among stakeholders
Sociocultural Barriers	Preference for traditional education methods and low awareness of the importance of digital education	Awareness campaigns to promote understanding and benefits of digital education, encouraging adoption of modern methods
Cybersecurity Risks	Increasing threats to data protection and user security	Develop advanced security policies and train users on cybersecurity best practices
Poor Updating and Management of Educational Platforms	Lack of specialists to update and organize platforms, affecting content quality and availability	Hire and train specialists to manage platforms and regularly update educational content
Challenges in Remote Exams and Assessments	Difficulty ensuring reliability and quality of digital exams, especially during the COVID-19 pandemic	Develop advanced electronic assessment systems with strict standards for remote exams
Need for Cultural and Methodological Change	Essential shift in societal attitudes towards digital education	Promote digital culture, provide governmental and institutional support, and ensure sustained coordinated efforts for successful transformation

7. Conclusion :

The extent of digital education in Algeria, as well as its conceptual framework, history, and variety of digital learning materials, were all explored in detail in this chapter. The evaluation draws attention to the crucial role that digital platforms will play in influencing professional education and training in the future by analyzing the primary types of digital platforms and their benefits and drawbacks. Aspects of the Algerian labor market analysis brought to light the ongoing problems with digital education, including outdated educational institutions, insufficient infrastructure, and graduates who are not employable, as well as the growing demand for IT and programming specialists.

These findings emphasize the necessity of reconsidering and redesigning procedures related to digital education areas in order to provide a sufficient response to Algeria's economic demands and bridge the gap between education and the workforce. This then discusses the study's objectives, which include identifying key concepts, assessing current platforms, and analyzing the opportunities and problems of digital learning in Algeria.

This chapter aims to prepare the reader for the following chapter, which examines the particular technical, educational, and marketing requirements associated with the design and implementation of a digital educational platform for Algeria that specializes in programming and information technology. It does this by laying out this theory and context. This modification guarantees that digital solutions for the nation's educational system are created within a logical framework and strengthens the alignment of the research with the study's goals.

CHAPTER 2

Requirements Analysis

1. Introduction

Requirement analysis is perhaps one of the most important steps and processes in the lifecycle of software development. Each phase relies on the previous phase, in this case,the current phase validates and collects the constraints based on the stakeholders'needs. For this specific study, this step of analyzing requirements sets the stage for designing a new digital platform aimed at teaching programming and artificial intelligence in Arabic and English by qualified teachers from Algeria. This chapter explains the defined methodologies of requirements engineering and detailed descriptions of the functional and non-functional requirements within the context of Algeria's sociotechnical environment.

2. Requirements Elicitation Methodology

2.1 Stakeholder Identification

all relevant stakeholders with their expectations and requirements must be identified and involved. For this project, the stakeholders are defined as follows:

- **Learners:** Individuals who want to learn or improve their programming and artificial intelligence skills.
- **Algerian Instructors:** Subject matter experts who develop and teach the course content in Arabic and English.
- **Administrators:** Individuals responsible for the day-to-day running of the platform, including the management of content and users.
- **Potential Partners**: Educational and training institutions, technology-related companies.
- **Employers:** Companies in Algeria hiring for jobs requiring digital skills.

***Table 8**:Stakeholder table.*

Stakeholder	Role	Needs/Expectations
Learners	Course end users	Accessible, engaging, and relevant content
Algerian Instructors	Teachers and content producers	Tools for course creation and student interaction

Administrators	Managers of platforms	Efficient management and monitoring tools
Potential Partners	Collaborators	Alignment with educational and industry standards
Employers	Those looking for skills	Graduates with market-relevant competencies

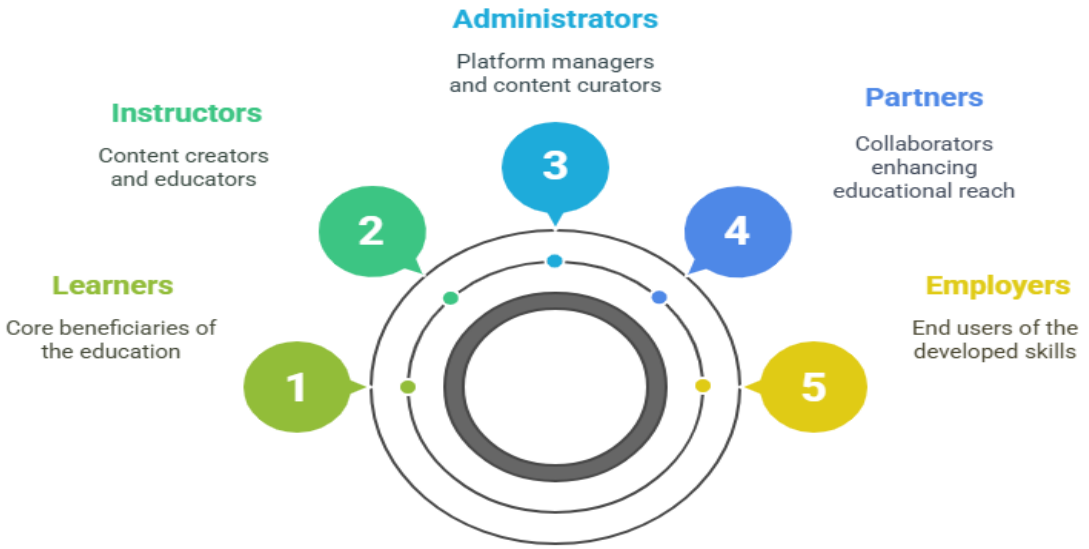

***Figure 3**:Stakeholder Map,*

2.2 Requirements Gathering Techniques

A multi-faceted approach was adopted to ensure comprehensive requirements elicitation, supported by tools such as Jira for requirements management and Miro for collaborative brainstorming:

- **Semi-Structured Interviews**: These provided qualitative data through interviews with teachers and digital education specialists.
- **Online Surveys:** Sent to learners to garner information on their expectations, learning styles, and technological limitations.
- **Competitive Benchmarking:** An overarching study of the top platforms to identify best practices and missing features.
- **Labor Market Analysis:** Analyzing the national IT workforce report to ensure the offered services on the platform align with the existing and future market demands.

- This screenshot is from Miro's tool for organizing requirements gathering tools:

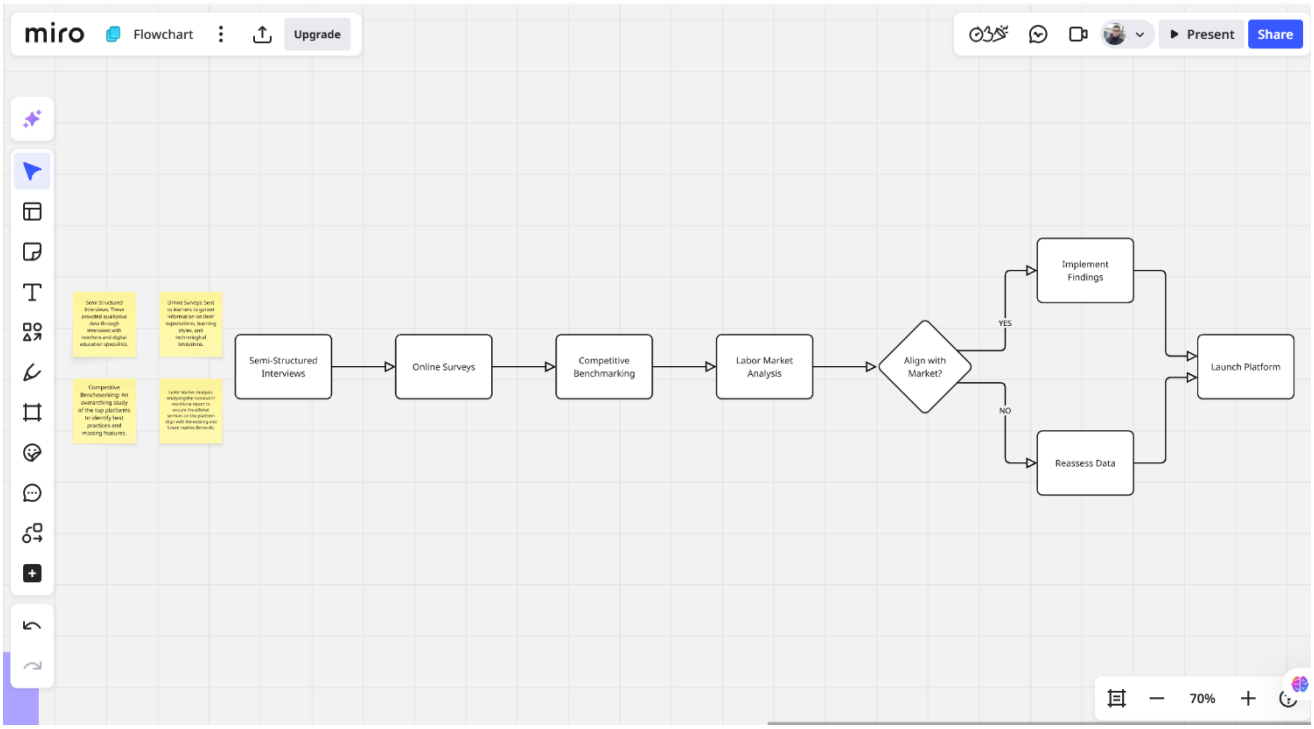

Figure 4: *Requirements Gathering Techniques.*

3. Functional Requirements

The functional requirements outline the critical operations and services that the digital learning platform must provide:

3.1 User Management

➢ **Authentication and Authorization (Mandatory)**

- Register and login secured with OAuth 2.0, learners, instructors, and administrators managed with JWT-based role access control (RBAC).
- Success Metric: Authentication services cost 99.9% uptime and user authentication within 2 seconds.

➢ **Profile Management (Mandatory)**

- CRUD (Create, Read, Update, Delete) for user profiles include preferences, passwords, and other credentials.
- Success Metric: Profile updates have 100% accuracy within one second.

3.2 Management of Courses and Educational Materials

- **Management of Educational Courses (Mandatory)**
  - Capabilities for course creation, course classification, administrative functions, and tagging of course information.
  - Success Measure: Course creation in less than 5 minutes.
- **Educational Materials and Multimedia File Uploading (Mandatory)**
  - Inclusion of multimedia resources (including but not limited to video, pdf, quizzes) with versioning and of metadata tagging.
  - Success Measure: Upload completion within ten seconds for files not greater than 100MB.
- **Courses language (Mandatory)**
  - A courses offered in both Arabic and English and the instructors' qualifications were checked.
  - Success Measure: All courses are accessible in both languages.

3.3 Communication and Collaboration

- **Discussion Forums (Mandatory)**
  - It offers asynchronous interaction for students, peers, and instructors.
  - Success measure: Posts made in forums will be available within a second after the forum submission.
- **Cohort Chat Rooms (Optional)**
  - Chat for course cohorts happens in real-time through websockets.
  - Success measure: Chat delay under 200 milliseconds.
- **Notification System (Mandatory)**
  - The system sends automatic alerts for emails and in-app notifications related to milestones, deadlines, and notifications within the course.
  - Success measure: Notifications are intact; 95% of them are successfully sent.

3.4 Evaluation and Maintaining Records of Progress

- **Automated Assessment Engine (Mandatory)**
  - Developing and assessing quizzes, assignments and exams.
  - Success Metric: Automated assessments achieving 99% accuracy in determining grades.
- **Learning Analytics Dashboard (Mandatory)**
  - Immediate visualization of learners activity such as dragging and overall participation.
  - Success Metric: Refreshing the dashboard over 2 seconds.
- **Digital Credentials (Optional)**
  - Awarding badges and certificates after finishing the course.
  - Success Metric: Automatic sending of certificates a day after the course is finished.

3.5 Billing and Subscription Administration (where relevant)

- **Payment Gateway Integration**
  - Integration with systems for secure baridimop,chargily.
  - Success Metric: 99.9% transaction success rate.
- **Subscription Lifecycle Management**
  - Management tools for single and bundled courses subscriptions.
  - Success Metric: Subscription modification completed within 5 seconds.

3.6 User Scenario Example

- Scenario: A learner enrolls and finishes a course:
  - **Actor**: A learner from Algiers.
  - **Action**: The learner registers an account, completes login, views the list of available courses, enrolls to an AI course, takes a quiz, participates in a discussion forum, and receives a certificate of completion.

- **System Response**: The platform validates the learner and shows him/her/them the relevant courses. The system fetches the payment received, automatically marks graded quizzes, logs forum participation, and issues a certificate digitally.

- **Outcome**: The learner is equipped with AI skills and an employment-aligned, foolproof credential.

This scenario will be supported by a scenario-specific diagram such as the Sequencen diagram.

4. Non-Functional Requirements

The quality attributes and limitations that control the system's functionality and user experience are specified by non-functional requirements.

4.1 Multilingual Assistance

A bilingual user interface ensures linguistic accessibility and localization by seamlessly alternating between Arabic and English.

4.2 Practicality

- User-centric design includes a responsive layout, easy-to-use navigation, and accessibility elements that meet global usability guidelines.

- Contextual adaptation: adjusting the user experience to conform to Algerian educational and cultural standards.

4.3 Effectiveness

- Low-latency operation: designed to be highly responsive even when bandwidth is constrained.

- Complete functionality on a variety of gadgets, such as tablets and smartphones, is known as mobile compatibility.

4.4 Security and Privacy Data protection

- modern encryption techniques are used to protect user data both in transit and at rest.

- Regulatory compliance: following international and Algerian laws on data privacy (such as the GDPR).

4.5 The Ability to Scale:

- Horizontal scalability: an architecture that can accommodate thousands of concurrent users without experiencing service degradation.
- Flexibility: future feature integration is made easier by modular design.

5. User Scenario: Enrolling in a Course and Completing an Assessment

➢ Context

Ahmed is a university student in Algeria trying to learn Python so that he can get a better job. He works with the learning platform by registering for a course, accessing its materials, and completing a self-evaluation test.

➢ Actors

- Houssam (Learner):A student who wishes to acquire some programming skills.
- Dr.Ahkrouf (Instructor):A specialist who is responsible for the creation and maintenance of the teaching materials for the course.
- System:The learning platform.

➢ Scenario Overview

✓ **Authentication**

- Houssam opens the app for the learning platform on his pc.
- He logs in into his account using the email and password, with authentication completed by a one-time code sent to his mobile phone (Functional Requirement: Authentication and authorization.
- His interface automatically shows up in Arabic which is his designated language (Non-Functional Requirement: Arabic and English language support with localization).

✓ **Course Enrollment**

- Through the system search of the platform, houssam looks for the ‘Introduction to Python’ course (Functional Requirement:Managementof Educational Courses).

- Dr. Akhrouf has uploaded over video lectures interactive quizzes in which he has authored, so he overview's the course (Functional Requirement: Educational Materials and Multimedia File Uploading).

- He processes to the end where houssam completes the enrollment and pays the course fee using a secure payment gateway. (Functional Requirement: Payment gateway integration).

- Through his automated systems, he receives in-app alert and confirmation email instantly after other notifications. (Functional Requirement: notification system).

✓ **Engagement with Course Content**

- During an online lecture video session, houssam is viewing the lecture on video. (Contextual Requirement: Bandwidth optimization for unreliable internet).

- He posts a question regarding a coding question that he has on the discussion of the course. (Functional Requirement:discussion forums).

- Dr. Akhrouf responds to his question and gives him the instructions after he has waited a whole day. (Functional Requirement:discussion forums).

✓ **Assessment and Certification**

- In order to gauge his knowledge on the topic, Houssam takes an interactive quiz that automatically grades itself and assesses the level of understanding he has of Python concepts.

- He receives his score immediately (non functional requirement).
- He observes his learning progress on the learning analytics dashboard that reveals completion and performance data (functional requirement: learning analytics dashboard).

- After completing the course, Houssam is issued a digital certificate which he is free to present to prospective employers. (functional requirement: certificate issuing).

Note: As for the dioramas, I will add them in the design chapter and all the scenarios will be explained through them.

6. Algerian Contextual Requirements

6.1 Infrastructure Limitations

Bandwidth Optimization: A platform designed to function dependably with inconsistent and low internet connectivity.

6.2 Linguistic and Cultural Aspects

- With the optional use of Algerian dialect in multimedia components, modern standard Arabic content ensures inclusivity and clarity.
- English for Advanced Learners: Designed for users preparing for a foreign job or certification.

6.3 Industry-Related Curriculum for Labor Market Alignment

- courses that correspond to in-demand competencies like cybersecurity, AI, and web development.
- Instructor Industry Experience: Giving preference to teachers who have demonstrable real-world experience.

7. Risk Analysis

We've put the potential risk analysis in an easy-to-read table :

***Table 9**:Risk Analysis Matrix.*

Risk Description	Likelihood	Impact	Mitigation Strategy
Low bandwidth affecting performance	High	High	Optimize media compression; implement offline caching
Insufficient instructor expertise	Medium	High	Partner with universities for instructor training

Budget overruns	Medium	High	Prioritize mandatory requirements; phased implementation
Data security breaches	Low	High	Implement MFA, regular audits, and encryption
Tight project timeline	Medium	Medium	Use agile methodology with iterative sprints

8. Requirements Traceability Matrix

As shown in Table , the comprehensive Requirements Traceability Matrix which outlined all the relevant functional, non functional, and contextual requirements is further mapped to the stakeholder needs. This matrix enables sustained traceability within the project lifecycle, associating each requirement with measurable criteria for success and expectations of the stakeholders, which assists the design, implementation, and verification processes.

***Table 10**:Requirements Traceability Matrix.*

Requirement ID	Description	Stakeholder Need	Priority	Success Metric
FR-1	Authentication	Secure access (Learners, Instructors, Administrators)	Mandatory	99.9% uptime
FR-2	Profile Management	Personalized user experience (Learners, Instructors, Administrators)	Mandatory	accuracy in profile

FR-4	Multimedia File Uploading	Accessible educational resources (Learners, Instructors)	Mandatory	Upload completion in <10 seconds for files ≤100MB
FR-5	Course Language	Linguistic accessibility (Learners, Instructors)	Mandatory	courses available in Arabic and English
FR-6	Discussion Forums	Peer interaction (Learners, Instructors)	Mandatory	Posts visible in <1 second
FR-7	Cohort Chat Rooms	Real-time collaboration (Learners)	Optional	Chat delay <200 milliseconds
FR-8	Notification System	Timely updates (Learners, Instructors, Administrators)	Mandatory	successful delivery of notifications
FR-9	Automated Assessment Engine	Accurate evaluation (Learners, Instructors)	Mandatory	accuracy in grading 99%
FR-10	Learning Analytics Dashboard	Progress tracking (Learners, Instructors, Administrators)	Mandatory	Dashboard refresh in <2 seconds
FR-11	Digital Credentials	Verifiable credentials (Learners, Employers)	Optional	Certificates issued within 24 hours

FR-12	Payment Gateway Integration	Secure transactions (Learners, Administrators)	Mandatory	transaction success rate
FR-13	Subscription Lifecycle Management	Flexible subscription options (Learners, Administrators)	Mandatory	Subscription changes in <5 seconds
NFR-1	Multilingual Support	Accessibility (All Stakeholders)	Mandatory	UI in Arabic and English
NFR-2	Usability	User-friendly experience (Learners, Instructors, Administrators)	Mandatory	Compliance with WCAG 2.1 accessibility standards
NFR-3	Performance	Responsive operation (Learners, Instructors)	Mandatory	System response time <1 second on 256 Kbps
NFR-4	Security and Privacy	Data protection (All Stakeholders)	Mandatory	Zero data breaches, AES-256 encryption
NFR-5	Scalability	Support for concurrent users (All Stakeholders)	Mandatory	Handle 10,000 concurrent users without degradation
CR-1	Bandwidth Optimization	Reliable access (Learners, Instructors)	Mandatory	Operable on 256 Kbps

CR-2	Linguistic and Cultural Adaptation	Cultural relevance (Learners, Instructors)	Mandatory	content in Modern Standard Arabic, optional Algerian dialect
CR-3	Labor Market Alignment	Market-relevant skills (Learners, Employers)	Mandatory	course content 90% aligned with IT job demands

9. Visual Summary of Requirements :

***Table 11**:Visual Summary of Requirements.*

Category	Key Requirements
Functional	Authentication, Course Management, Forums
Non-Functional	Multilingual, Scalability, Security
Contextual	Bandwidth Optimization, Cultural Alignment

10. Conclusion

The feedback from stakeholders, as well as benchmarks against best practices, and technical and sociocultural constraints have all been woven together to fulfill best practices in stakeholder interaction in analyzing requirements pertaining to system eligibility checks for the development of a comprehensive digital learning system for Algeria. The functional, non-functional, and contextual requirements described in this document form the basis for the later architectural design and system implementation phases. For instance, functional aspects like “secure authentication” and “interactive discussion forums” will determine which system components are to be constructed, while more artistic details will be expressed in design documents, including UML diagrams to be included in the report’s use case and class diagrams, as well as data flow diagrams in the upcoming chapter. Non functional aspects of the infrastructure that need sytem-performed scalability include

defined practical need support in simultanously performed requests, security measures, and multilingual capabilities will influence decisions regarding cloud-based settings versus localized systems to enhance sytem-performed accessibility.

Considerations such as bandwidth restrictions and cultural alignment will guide the design to fit Algeria's infrastructural kihda and xenolinguistic diversity gaps so that the platform is useful and pertinent to the audience. In the upcoming Chapter 03 these requirements will be captured in a complete system architecture and system design specifications. The chapter will contain several diagrams depicting the system as well as its interactions, showing the systems structure and workflow as design components based on requirements. The chapter will also describe the design approaches perhaps agile or prototyping,that would best fulfill the criteria within the specified timeframes compelled by the requirements. Usability screenshots of the platform's user interface will demonstrate how the requirements, especially those pertaining to cultural adaptation, are presented on the system's front end. Focus on requirements on this level during the design phase allows for a project funneling approach to defining the scope which in this case is building a digital learning platform focused on the educational realities of Algerian learners, automotive market expectations, local constraints for sociotechnical balance.

CHAPTER 3

System Architecture

1. Introduction

In this chapter, we will center on determining the system architecture that acts as the framework for constructing the software solution. Specifically, focus on creating a structure which is well organized and coherent as discussed in previous chapter. Accomplishing this will enable the system to have both functional and non-functional capabilities while tailoring the system to the constraints present in the Algerian environment.
We will elaborate on the chosen development methodology and justify its selection considering the objectives and limitations of the project. The chapter describes the fundamental parts of the system and their relationships, including the complete architectural diagrams. Finally, great emphasis is given to primary local design considerations such as the infrastructural bounds and the reality of cultural pluralism. This enables the system to be relevant and useful to the intended audience.

2. System Development Life Cycle (SDLC) and Methodology Selection

2.1 Adopted System Development Life Cycle

This project follows the Waterfall model, which is part of the System Development Life Cycle (SDLC). With this approach, there is a step-by-step software development process, starting from requirements collection and ending at deployment. Each step in the process provides a definite stage which has to be finished to progress to the next stage.

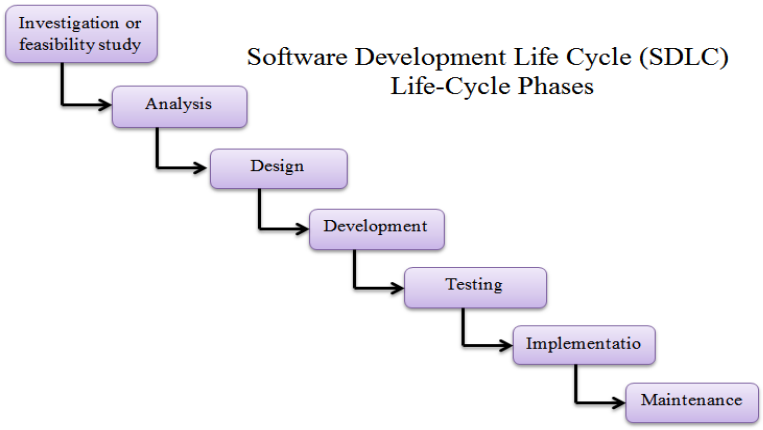

Figure 5:*System Development Life Cycle (SDLC).*

2.2 Selected Development Methodology: The Waterfall Model

The Waterfall Model is a sequential or linear approach to project management that operates according to predetermined deadlines, specifications, and results. Teams can function independently unless certain integrations are needed, and they don't need constant communication. In addition to being able to work autonomously, team members are typically asked to submit status updates less regularly (in contrast to an agile strategy)(IBM Developer, 2019).

The following phases comprise a typical Waterfall project, which is chronological in nature:

Requirements
Written requirements, which are typically combined into a single document and used to verify each step, are created during these five stages along with the project's functional and non-functional requirements and constraints. Assumptions, risks, dependencies, success indicators, and completion timeframes are all given, along with the cost. [31]

Design
The goal, the project's scope, the basic traffic flow of each component, and the integration points (the topology) are all described in a high-level design (HLD). This is followed by a comprehensive design that enables subject matter experts (SMEs) to implement the HLD design in great detail. [31]

Implementation
Implementation teams develop, code, deploy, and test the solution in accordance with the design. Since the team that designs the system may or may not be the same, it is imperative that the one written document be as clear as possible. A new design must be made and approved before the implementation is finished if modifications are needed during the implementation phase (for example, because of unanticipated problems with the design, integrations, or even modifications to the system's intended function). [31]

Verification
In order to verify that the project satisfies initial expectations, acceptance tests are then implemented and carried out during the verification phase. The developed solution is then further verified against the requirements. If not, a review is carried out to ascertain any ratification steps and an investigation is conducted to establish the deficiencies. [31]

Maintenance
Finally, a specialized ownership team makes scheduled adjustments when defects are reported or new product versions are required (maybe because they are no longer supported). The Waterfall Model requires that each step be finished and approved before moving on to the next. [31]

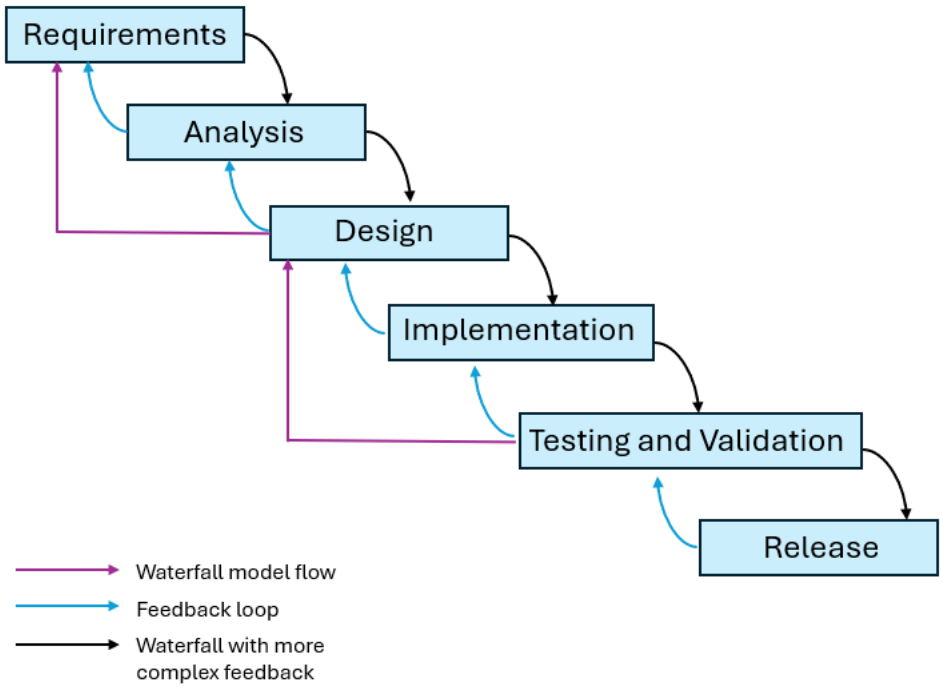

***Figure 6**:Waterfall Model.*

2.3 Justification for Selecting the Waterfall Model

The selection of the Waterfall methodology for this project stems from both practical and theoretical reasoning that aligns with its features.

Clear and Finalized System Requirements: As the system's only developer and as the end-user myself, I was able to define and finalize the requirements using the Waterfall model's assumption of requirement stability.

Solo Development: Since no client interactions were needed, the development activity was self-contained, allowing a linear model to be applied rather than iterative models like Agile.

Academic Form: Academic projects have unique requirements for structured documentation, progress tracking, and defined phases, all of which are intrinsically facilitated by the Waterfall model.

The model's estimation and control capabilities have an added value: tracking progress at every stage is considerably easier compared to other models.

All factors indicate that the Waterfall model provides a more controlled and clearer development process, which is why it was chosen for this educational digital platform given the project's academic and technical circumstances.

Future iterations of the platform may adopt an Agile methodology to accommodate user feedback and evolving requirements.

3. System Architecture Design

3.1 Overview of Core System Components

The web-based educational platform is developed using a modular and multi-layered system to address specific components in the system. This system allows the platform to scale more easily and improve system upkeep. Moreover, it allows for the independent development of key features. The primary system components include:

- User Interface (UI): An interface accessible through the web that is responsive and allows different users of the system: learners, instructors, and administrators to use the system. It performs data capture as well as content display of the system dynamically.

- Application Logic (Business Layer): This component supervises the main services of the platform which are user registration, course delivery, test administration, progress monitoring, and access control based on user roles.

- Data Access Layer: Facilitates the retrieval and storage of data in the database as between the business logic and the database system.

- Database: Contains semi-structured data such as users, courses, lessons, materials, assessments, system logs. Uses relational databases such as MySQL to uphold data accuracy and consistency.

- Security and Authentication Module: Controls active user sessions, manages logins and passwords, user roles, barriers to protected resources, and safeguard against breaches to restricted areas.

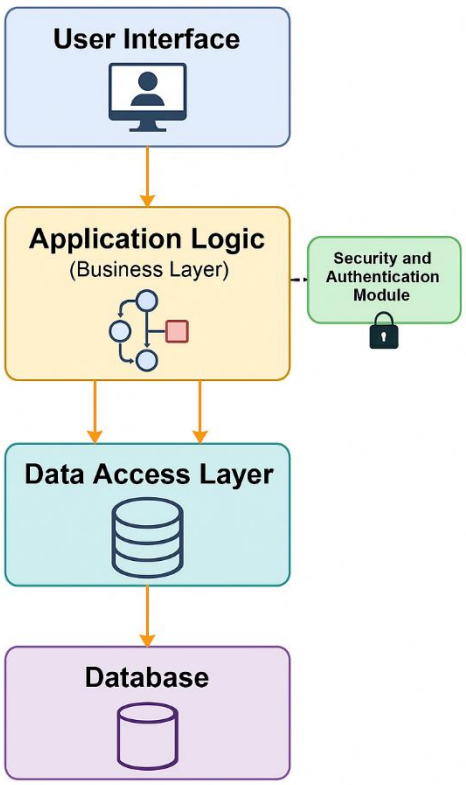

***Figure** 7:Core System Components.*

The typical documentation of system architecture references the front-end and back-end development layers. The front-end is usually referenced on the User Interface layer and the back-end is typically referenced on the Business Logic, Data Access Layer, and Database layer.

3.2 Description of Interactions Between Components

The interactions among the components can be seen in a logical and coherent flow that is standard in layered web systems:

1. A user initiated the interaction with the UI (logging in; selecting a course, submitting a quiz, etc.).

2. The application logic layer receives this interaction and processes the input, applying business rules while validating users' actions (based on the user role).

3. If the action continues with what was initiated and access to the database is required (retrieving course information; storing test scores, etc.), the logic layer communicates with the data access layer.

4. The data access layer performs the necessary actions in the database and returns results to the application logic.

5. The application logic returns the output to the UI, and again the UI updates based on the returned information.

This interaction model, which supports separation of concerns, makes debugging and testing system components easier and adheres to design best practices for modern web-based systems.

3.3 Technical Mapping of Functional, Non-Functional, and Contextual Requirements

The system architecture was methodically created to meet all varieties of requirements identified in the Requirements Analysis phase.
- **Functional Requirements**: Features include account management, course delivery, content uploading, assessments, and certificate generation. All of these components are largely automated within the application logic and represented in the UI and database schema; thus each function has a designated user role and user task.
- **Non-Functional Requirements**: Several key characteristics were identified:
Performance: implemented through using light-weight UI components, an object-oriented database and queries optimized for performance.

- Security: by way of session control, encrypted authentication and access rights management (user type).
- Scalability: architected to be modular and with the possibility of moving to the cloud or a cloud-based infrastructure.

- **Contextual Requirements**: adaptations made relevant to the Algerian context are:
- Low-bandwidth: front-end design is simple and fast-loading to ensure accessibility even in areas with limited internet infrastructure.
- Multilingual: the complete interface is available in Arabic and French to support multi-lingual contexts.
- Employment generation: course components were modulated to support job opportunities in the technology sector, which is increasingly relevant to the Algerian job market.

In summary, the system architecture carefully reflects both the technological requirements, and the suffered from socio-cultural context of the potential users; hopefully ensuring a system both functional for their needs, and is locally relevant.

3.4 High-Level Design (HLD)

The High-Level Design (HLD) illustrates a modular architectural vision of the digital learning platform. It shows how the core system components interoperate in a structured, layered manner that allows scalability, maintainability, and consideration for the socio-technical context of Algeria. The Main design level contextualizes the requirements to implementation phase, and indicates a distinct purpose for each module.

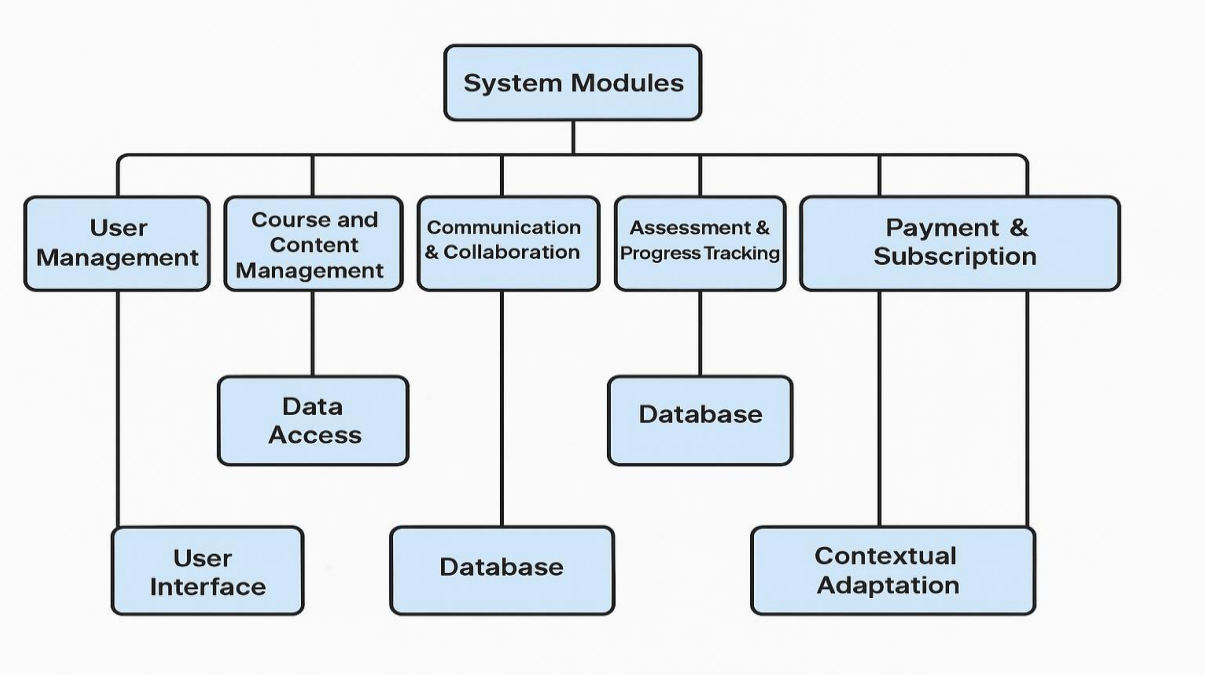

***Figure 8**: High-Level Design (HLD).*

User Management

Involves user registration, login, authentication via OAuth 2.0 and JWT, and roles access control for learners, instructors, and admins. Handles communication directly with the user interface to provide customized access.

Course and Content Management

Allows users to create, classify and tag the courses, upload multimedia (videos, PDFs, quizzes), and deliver content in two languages (Arabic and English). Involved Data Access Layer and Database communication.

Communication & Collaboration

Contains discussion forums, real-time chat, and notifications for cohorts. Facilitates user interaction and stores messages and alerts in their database.

Assessment & Progress Tracking

Includes quizzes, automated grading, learning analytics dashboards, and certificate generation. All data can be stored and retrieved from the database located in the central database prior to displaying on the UI.

Payment & Subscription management
Processes transactions through local gateways (BaridiMob, Chargily) and manages course subscriptions. Aligned contextual adaptation module for local payment systems.

Data Access Layer
Serves as a pathway connecting application logic to the database. Guarantees the security and optimized retrieval and persistence of data.

User Interface (UI)
Provides a responsive and bilingual web interface available on multiple devices. Displays dynamic content based on user roles and permissions.

Database
Holds user data, course material, assessments, logs, and communications. Ensures consistency and integrity of the data the system is working with.

Contextual Monitoring
Modifies system to accommodate Algerian constraints, taking issues such as bandwidth, language and connection to the labour market into account during course design.

4. System Architectural Diagrams

From the analysis of functional and non-functional requirements and the discussion about the Algerian context considerations provided in Chapter Two, we have created a series of Architectural Diagrams that illustrate the whole system and its interactions. These diagrams take us from requirements analysis to the detailed designs and implementation phase. The diagrams include: Context Diagram, Component Diagram, Deployment Diagram.

4.1 Contexte Diagram

A Context Diagram provides a high-level view of the system's knowledge of its interactions with external entities. It displays the system (digital learning platform) as a single unit, surrounded by various actors, rather than showing the internal workings of the system. This is a useful way to discuss how the platform fits within its environment.

The following are key external actors:

Learner: registers to the platform, access course material, complete assessments and receive certificates.

Instructor: uploads course content, assesses learners and engage in forum discussions.

Administrator: manages users, course content and the function of the platform.

Partner: represents the university or training organisation collaboration on content creation or delivery.

Employer: confirms validity of certificates issued or reviews graduate profiles for recruitment.

Payment Gateway: enables secure financial transaction online.

Notification Service : sends alerts and reminders to users.

- Purpose of the diagram:
  To establish the boundary of the system and clarify the information that is exchanged with external actors to support internal systems design.

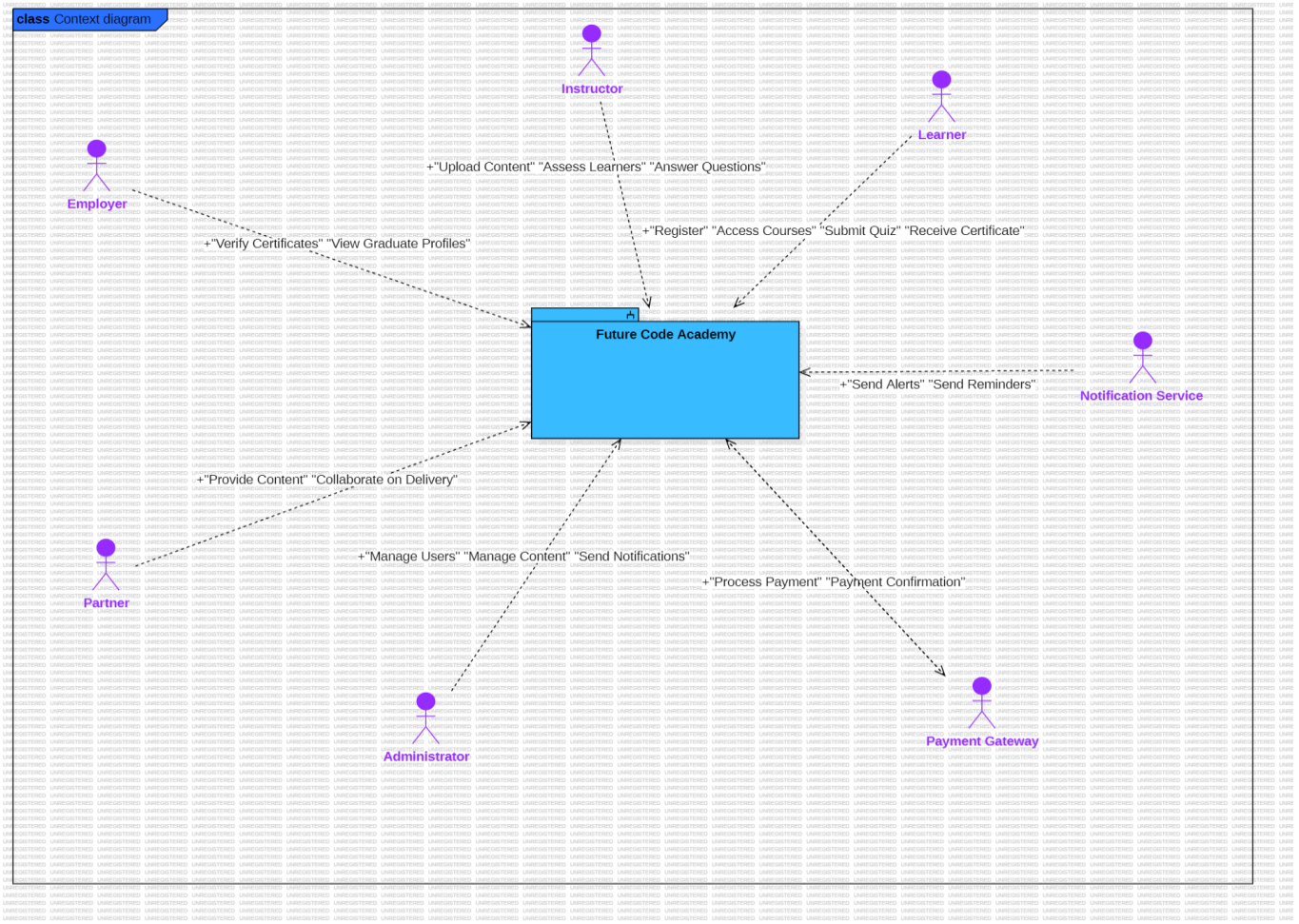

***Figure 9**:Contexte Diagram.*

4.2 Component Diagram

The Component Diagram describes the major software components of the platform and how they are functionally grouped and relate to one another. Each of the components contains a specific set of responsibilities that can be created and tested independently.

The components are grouped based on their functional domains as follows:

User Management Components

AuthenticationComponent: Covers the security of signing in using OAuth 2.0 with a JWT token.
ProfileManagementComponent: Allows you to change or edit your personal profile.
AccessControlComponent: Implementation of access control policies according to rules assigned to certain roles of users.
UserManagementComponent: The main component is to allow the record storage of user accounts, issue records, and manage the same access permissions that are relevant to the account users.

Course Management Components

CourseCreationComponent: Allows instructors to create and fully manage courses.
MaterialUploadComponent: Allows an instructor to upload their course materials (videos, pdf files, etc..).
MultilingualComponent: Ensures content is in Arabic and English language.
CourseTaggingComponent: Is responsible for the metadata descriptors learners were given along with their courses.
CertificateComponent: Issues certificates that describe accomplishments learned on digitally once a learner has successfully exceeded the requirements parameters under from courses over a specified period of time.

Assessment & Analytics Components

AssessmentComponent: The key features are automated grading of quizzes and assignment submissions.
AnalyticsDashboardComponent: Graphical visualizations of the learners interaction and use of the mode.
ResultComponent: Final grading of the assessment (collated and persistent file assessments).
FeedbackComponent: Individual feedback based upon users participation.

Communication Components

ForumComponent: Asynchronous communication between users.
ChatComponent: Synchronous text communication between users.
NotificationComponent: Automation of messages and updates about the courses for participants.

Billing and Subscription Components

PaymentGatewayComponent:Implementation of BaridiMob and Chargily API's.
SubscriptionComponent: Management of user subscription to the course.
InvoiceComponent: Receipts and payment tracking.

General Infrastructure Components:

UIComponent: Interface relating to how each user interacts with the system itself.
LoggingComponent: Logging of each users actions for secure and audit purposes.
SecurityComponent: Securing and encrypting the data for all of data in motion and rest.
LocalizationComponent: which also included language and culture.

- Purpose of the diagram: To define the internal software architecture and to demonstrate the separation of concerns, supporting the modularization, maintenance, and extensibility of the system.

***Table 12**:Dependencies Table.*

From Component	To Component	Type of Dependency	Functional Description	Significance in the System
UIComponent	Authentication Component	API Call	Sends login credentials from user interface to authentication service	Ensures secure access and prevents unauthorized login
UIComponent	Profile Management Component	Update Operation	Enables users to modify their personal profile data	Supports personalization and user autonomy
UIComponent	CourseCreation Component	Create/View	Allows instructors to create and manage their courses	Core function for educational content management
UIComponent	MaterialUpload Component	File Upload	Uploads educational content (videos, PDFs, quizzes)	Enriches learning material diversity
UIComponent	Assessment Component	Start Operation	Initiates quizzes or exams through the interface	Facilitates learner evaluation and performance tracking
UIComponent	Notification Component	Display Alerts	Displays system notifications and messages to the user	Enhances engagement and informs users about actions
UIComponent	Certificate Component	Download	Allows learners to download certificates after completion	Motivates learners and adds credibility to achievements

Profile Management Component	Authentication Component	Use Credentials	Uses authentication data for verifying sensitive profile changes	Maintains profile security and integrity
Assessment Component	CourseCreation Component	Read Course Info	Retrieves course-related data for linking assessments appropriately	Ensures relevant and aligned evaluations
Assessment Component	Notification Component	Send Results	Sends quiz results to the notification module	Improves responsiveness and learner feedback
Assessment Component	Analytics Dashboard Component	Provide Performance Data	Sends assessment analytics to display on performance dashboards	Supports system monitoring and learning optimization
Certificate Component	Assessment Component	Check for Pass	Verifies user's eligibility for certification based on exam results	Prevents invalid or premature certificate issuance
ChatComponent	UserManagement Component	Fetch User Info	Retrieves user identity details for chat interactions	Enables personalized communication
ForumComponent	UserManagement Component	Fetch User Role	Gets user roles to determine permissions in discussion forums	Ensures role-based access and moderation
Subscription Component	PaymentGateway Component	API Call	Sends payment requests to local gateways (BaridiMob, Chargily)	Integrates financial transactions with local payment providers
Subscription Component	Notification Component	Send Confirmation	Notifies users after successful subscription or payment	Confirms transactions and enhances trust
Notification Component	UserManagement Component	Fetch Contact Info	Retrieves contact data (email, phone) to send alerts and updates	Connects alert system with actual user communication channels

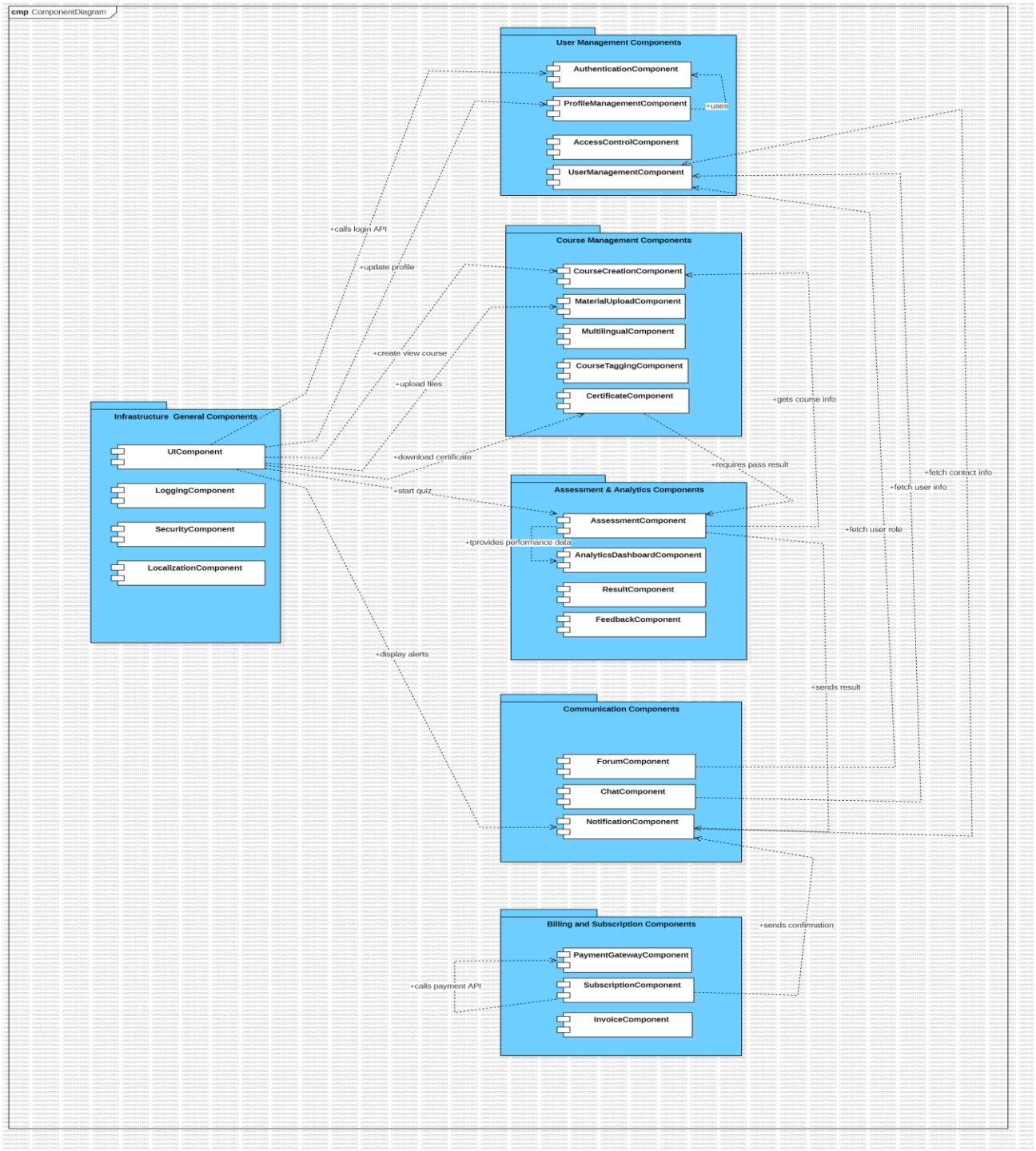

Figure 10:*Component Diagram.*

4.3 Deployment Diagram

The Deployment Diagram illustrates the mapping of the system's software components to their underlying hardware or cloud infrastructure. It shows how the platform is deployed to several servers and client devices.

The anticipated new infrastructure includes:

- **Client Devices (PCs, Smartphones):** End-users access the system through web or mobile interfaces.
- **Web Server:** Hosts the front-end interface and static assets of the platform.
- **Application Server:** Executes the business logic and processes requests from the Web Server.
- **Notification Server:** Responsible for sending emails and in-app messages.
- **Database Server:** Stores user data, courses, assessments, system logs etc.
- **PaymentGateway:** Deals with secure transactions and payment confirmations
- **AuthServer:** Responsible for authentication session tokens, and identity validation.

- Purpose of the diagram: To illustrate the physical and virtual environment in which the platform operates to support the nonfunctional requirements of the system (e.g. performance, scalability, security).

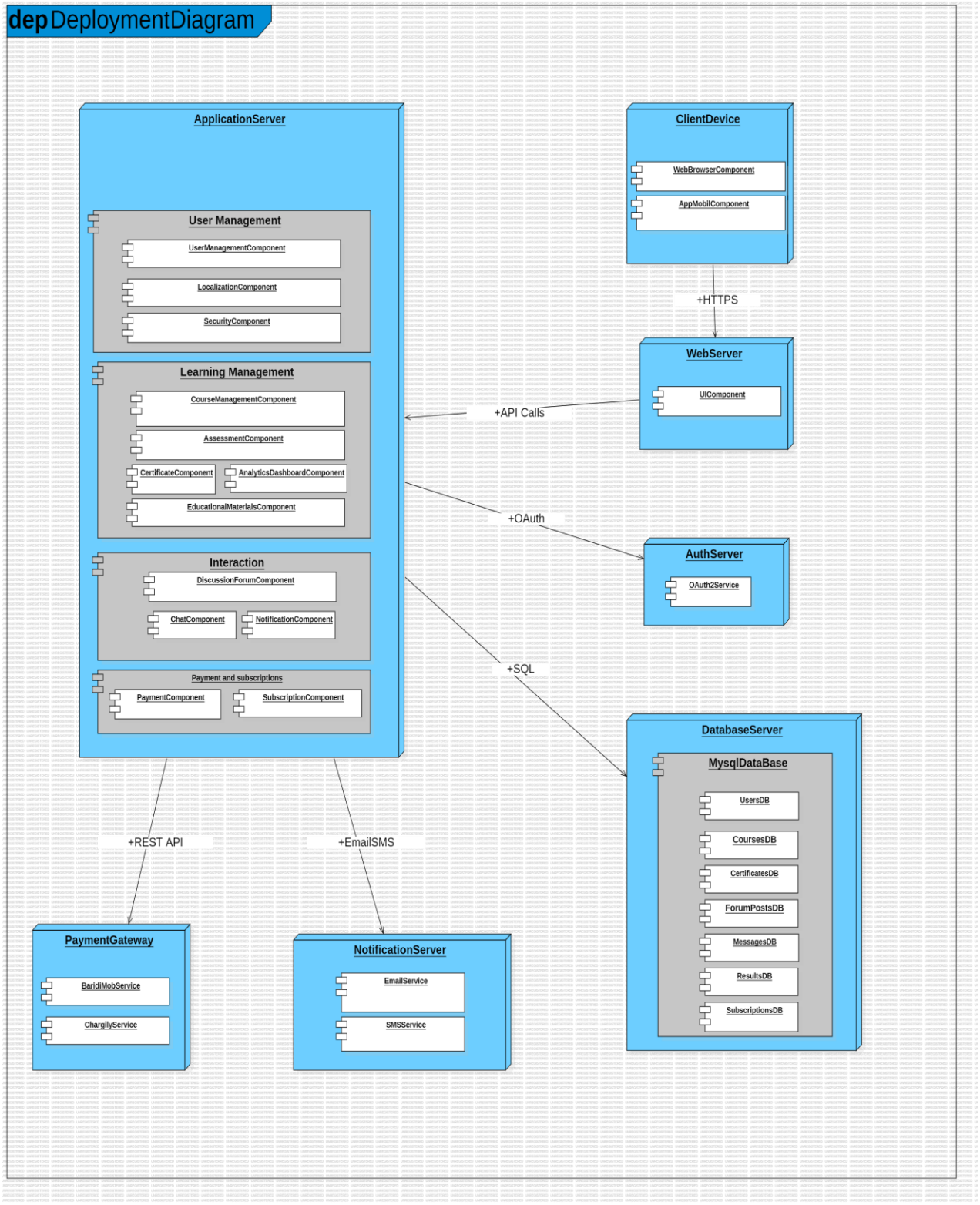

***Figure 11**:Deployment Diagram*

5. Considerations Specific to the Algerian Environment

5.1 Infrastructure Constraints (Bandwidth Limitations)

Like other developing nations, Algeria is still limited by internet infrastructure, especially in rural, or developing areas. In order to overcome these limitations, the system architecture utilized a lightweight front-end design that minimizes data usage, compressed assets and avoided heavy real-time data transfer wherever possible. Caching options and the minimum of page reloading were considered, to offset latency and uphold accessibility over low-bandwidth networks.

5.2 Cultural and Linguistic Diversity

Algeria's cultural and linguistic diversity is complex. To making the platform as inclusive as possible, the design aims to support bilinguals and bilingual content and interfaces. In regards to the user interface (UI), it should easily switch between Arabic or English based on the user's choice. With regards to course materials, we will encourage groups to be multilingual to accommodate our diverse user base as much as possible. Accommodating multiple orientations and ways of learning will ensure content is usable and engaging among learners from various regions and/or language backgrounds.

6. Conclusion

This chapter has provided a sound architectural foundation for developing the digital learning platform by methodically elaborate and design the system architecture. A formal method, the Waterfall model was used, to match the academic context of the project and the stability of the requirements. This method allowed for a sequential, linear fashion of system development, where part of the system could be built and tested before the next component, and so on.

The architectural design was detailed through three diagrams - the Context Diagram that provided an overview of how the platform interfaces with external actors; the Component Diagram that compartments the platform's internal elements, and their functional responsibilities; and the Deployment Diagram which relates the software components to their physical / virtual infrastructure. Together they articulate a clean and modular architecture for the system, allowing us to accommodate changes easily, while respecting the principles of separation of concerns.

Along with the technical architecture, the chapter articulated the socio-technical context for Algeria which related to bandwidth, extent of use of English/Arabic, payment methods, etc. These contextual considerations were implemented into the architecture of the system so that the learning platform is accessible, relevant, and ultimately useful to the users of the system.

As we continue into the future, the next chapter will deepen the architectural aspects of this chapter by shifting from the more abstract architectural aspects to lower-level system design. In this chapter, we will represent the components in UML-based design models, which include Use Case Diagrams, Class Diagrams, Sequence Diagrams, and State Diagrams. We will also produce mocks for interfaces, and user interaction scenarios that relate the structure of the system to the user experience (UX). This is an important shift in that it allows for testing the behavior of our system, it assists the implementation, and helps ensure we continue to engage with users and technical constraints.

CHAPTER 4

Detailed System Design and Validation

1. Introduction

With the architectural foundations outlined in Chapter Three, this chapter focuses on the detailed design that can be constructed from the high-level system architecture. While Chapter Three described the major components of the platform, and described the interactions between them in a layered architecture, we will look at the inner design of these components: how things will be built, how components will interact together, and how they will ultimately provide needs to users within the real-world prototype.
In this chapter, we will aim for three primary objectives: first, to bring a complete, orderly depiction of the system through a series of UML-based diagrams that formalize the behaviors and structure of the platform's modules; second, to describe the user interface and user experience design in a way that embodies not only technical best practices, but also culturally-localized practices; finally, to verify the soundness of the design, prior to commencement of development, ensuring it meets the identified functional and non-functional requirements. This chapter, thus, solidifies the link between conceptual system architecture and development, consistency, clarity, and viability as the platform moves from concept to working prototype.

2. From Architecture to Detailed Design

As was set up in Chapter Three, the architectural model provided a modular, multi-layered solution for the educational platform which included all the main components including User Interface, Application Logic, Data Access Layer and Database as well as supporting services that include authentication, notifications and payment integration. Each component will also need to be examined in terms of their competing roles and interdependencies, as well as how they will be deployed across physical and virtual infrastructures. Furthermore, each component places itself within contextual and socio-technical environments while ensuring that we relate these components to constraints (like low bandwidth) in an Algerian context and bilingualism.

Having structured the architecture, moving from High-Level Design (HLD) to Low-Level Design (LLD) means deciding on the internal structures of each module and working with the interfaces, operations and behaviours in a precise manner. The HLD established the system's context, highest order structure, the LLD focuses on precisely how each component will be technically implemented (not necessarily directly to fulfil the HLD) and how the parts will interact during runtime scenarios. The LLD covers the level of detail of, for example, class structures, data models, control flow diagrams, and user- interactions with sufficient detail to provide a useful picture to guide the developer implementers.

The move to LLD was informed by functional requirements (for example, user registration, course management, and issuing certificates), and non-functional constraints (for example, performance, scalability, and security). In this chapter, we will use UML modeling techniques such as Use Case Diagrams, Class Diagrams, and Sequence Diagrams to describe the design in a more technical manner so that the prototype can be implemented in a consistent, efficient, and manageable way.

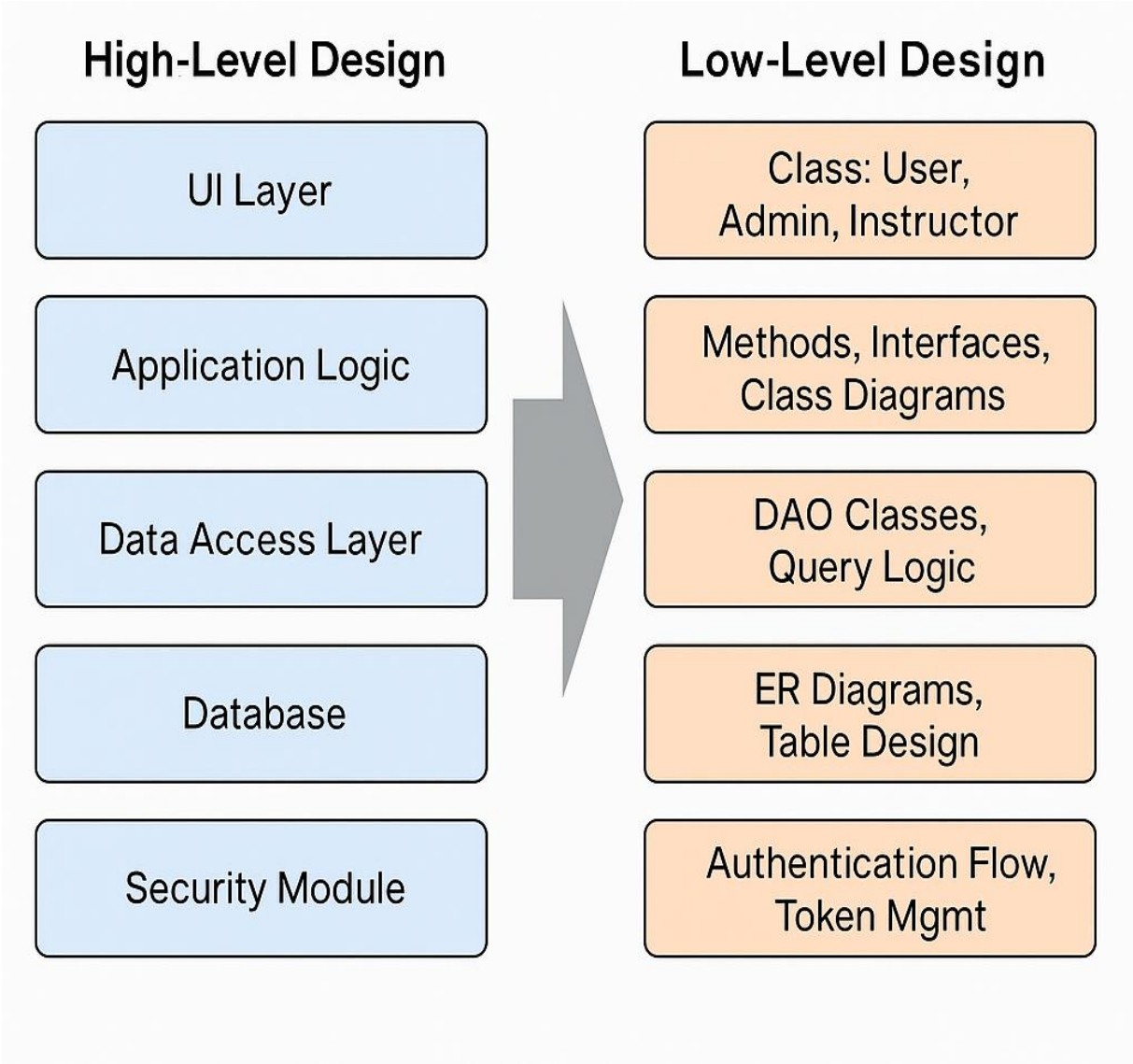

***Figure 12**:HLD TO LLD*

Comparison between High-Level Design and Low-Level Design in the Proposed System

***Table 13**: Comparison between High-Level Design and Low-Level Design in the Proposed System.*

Aspect	High-Level Design (HLD)	Low-Level Design (LLD)
Purpose	Defines the overall structure and architecture of the system.	Specifies the internal implementation details of each component.
Level of Abstraction	Abstract, component-level view.	Concrete, class- and method-level view.
Based on	Functional decomposition of system requirements.	Implementation of functionalities within modules.
Components in Your Project	UI Layer, Application Logic, Data Access Layer, Database, Security Module.	Classes: User, Instructor, Course, Certificate; Methods, Interfaces, Authentication Flow.
Tools Used	Context Diagram, Component Diagram, Deployment Diagram.	Use Case Diagrams, Class Diagrams, Sequence Diagrams, State Diagrams.
Output Examples	Modular system blocks and interrelations.	Class hierarchies, control flows, database schema, interaction sequences.
Audience	Architects, analysts, decision makers.	Developers, testers.
Chapter in Thesis	Chapter 3: System Architecture	Chapter 4: Detailed System Design and Validation

3. System modeling using UML diagrams in its design

3.1 System Modeling Using UML Diagrams

The Unified Modeling Language (UML) is a standardized graphical language that provides a way for software system engineers to visualize, specify, construct, and document the artifacts of a software-intensive system. “UML is a graphical language for visualizing, specifying, constructing, and documenting the artifacts of a software-intensive system” (Booch, Rumbaugh, and Jacobson, 2005, p. 2). UML offers a wide variety of diagrammatic tools that can be utilized to model both the static structure and the dynamic behavior of a system. [32]

One goal of UML is to provide system architects, software engineers, and analysts a common vocabulary while modeling system designs. Another goal is to support the analysis and design stages of software development life cycle in addition to supporting the communication of design between all parties, including stakeholders. The combination of UML diagrams such as Use Case, Class, Sequence, and State diagrams

gives readers a complete technical model for the software realization of the platform presented in the previous chapters. [32]

Although some UML diagrams were previously introduced in Chapter Three, this section provides a structured and detailed overview of the language and its modeling role in system design.

3.2 Use Case Diagram

The Use Case Diagrams are intended to depict the interactions of different actors and the system depending on the functional requirements established in Chapter Two. Each Use Case Diagram illustrates a grouping of use cases describing specific services of the platform that users will interact with (i.e., select and/or trigger the use case). So the diagrams represent a use case as initiated by the user's interactions. Use Case Diagrams are the representation of the developing behavioral models and enable a high-level understanding of the system functionality from the user's perspective.
In terms of the platform considered in this study, the main actors: Learners, Instructors, and Administrators will have different use cases with the platform depending on their roles and expectations that come from the requirements elicitation phase.

As an example:

A Learner can register, log in, search and enroll in courses, use discussion and forums, take quizzes, monitor progress on the dashboard, and earn certificates.

An Instructor can create courses and manage them, upload content, monitor Learner's progress, and communicate with Learners through forums or chat.

An Administrator can control everything about the platform such as users and managing course, and performance analytics.

- Use Case Diagram Includes:

***Table 14**: Use Case Diagram Includes*

Actor	Use Cases
Learner	Register / Log in View Courses Payment and Subscription Enroll in Course Take Assessment (Quiz / Exam) Participate in Forum View Learning Analytics

Administrator	Register / Log in Manage Users SendNotifications Manage Courses Receive Certificate
Instructor	Register / Log in Manage Courses Upload Course Materials Participate in Forum View Learning Analytics

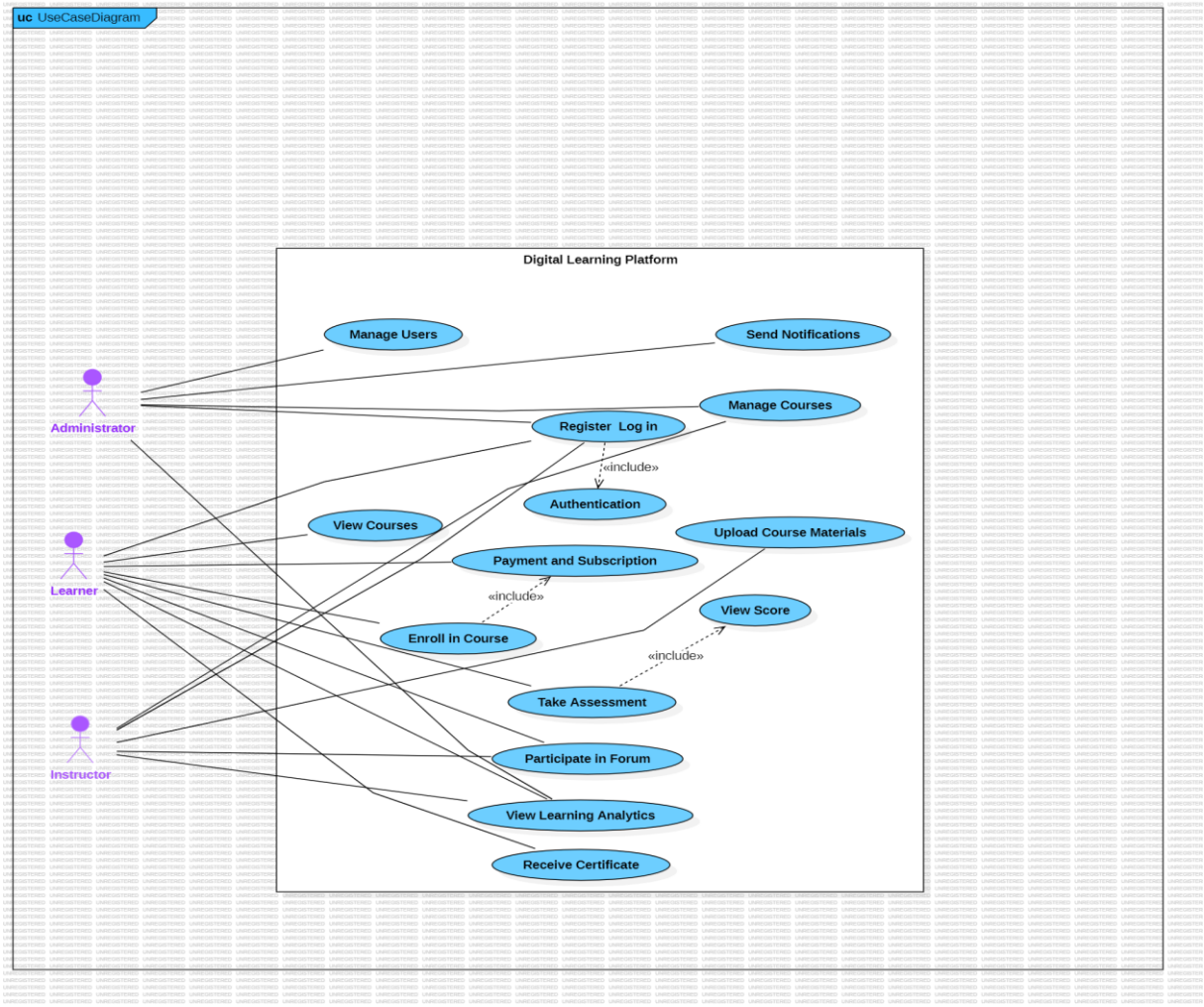

Figure 13: *Use Case Diagram.*

3.3 Class Diagram

The Class Diagram provides a structural representation of the system by defining the main classes, their attributes, and methods, and the relationship with other classes. The Class diagram acts as a guide to object-oriented implementation of the platform transitioning from the high level architectural version (Chapter Three) into a low-level design format.

The classes have been established on the functional requirements from Chapter Two and the architectural components described in Chapter Three. Each class is establishing a different aspect of the system: user, course, assessments, forums, payments, administrative functions, etc.

All attributes are strictly private, to "hide" the data (encapsulation), and where applicable must be accessed using public methods. This follows best practices of object-oriented theory which will also allow maintainability, extensibility and security.

Class relationships define other classes with inheritance (e.g. Learner, Instructor, Administrator inherit from User), associations (e.g. Learner initiated course Enrollment to Course), and composition (e.g. Course IS-COMPOSED-OF many Lessons) are examples of real interactions and data within the platform.

The full Class Diagram for the platform, with class attributes, methods, access levels and relationships are identify, that guide the software development process is shown below.

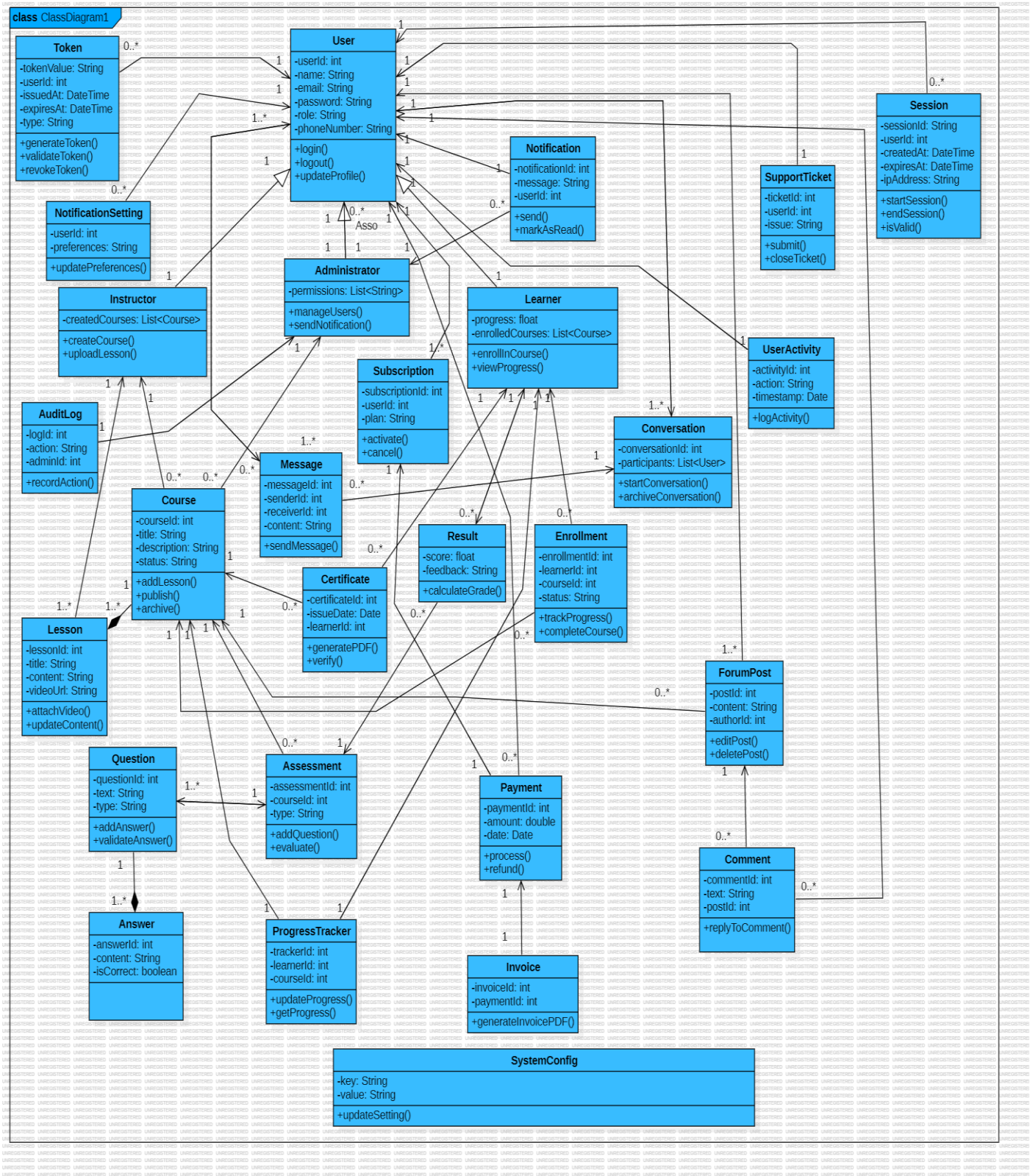

Figure 14: *Class Diagram.*

- **List of Classes :**

1. User Management :

- User: Generic user class containing attributes such as name, email, password, and role.
- Learner: Inherits from User; represents a student enrolled in courses.
- Instructor: Inherits from User; represents a content creator or teacher.
- Administrator: Inherits from User; responsible for system management.
- Session: Handles session management after login.
- Token: Manages authentication tokens using JWT or OAuth.

2. Course Management

- Course: Represents a course with title, description, category, and status.
- Lesson: Represents individual learning units within a course.
- Enrollment: Tracks learner's enrollment and progress in a course.

3. Assessment & Certification

- Assessment: A quiz or test associated with a course.
- Question: Individual questions within an assessment.
- Answer: Possible answers for a given question.
- Result: Learner's performance score in an assessment.
- Certificate: Credential issued upon course completion.

4. Communication & Forum

- ForumPost: Posts made in course-specific discussion forums.
- Comment: Replies to forum posts (optional).
- Message: Private messages between users.
- Conversation: Represents a thread of messages between users.

5. Notifications

- Notification: System-generated alerts sent to users.
- NotificationSetting: User preferences for receiving notifications.

6. Payments & Subscriptions

- Subscription: User's access plan or premium enrollment.
- Payment: Records of payment transactions.
- Invoice: Billing documents for transactions.

7. **Analytics & Tracking**
    - UserActivity: Tracks system interactions by users.
    - ProgressTracker: Monitors user progress within a course.

8. **System Configuration & Admin Tools**
    - SystemConfig: Stores global configuration settings.
    - AuditLog: Logs system-level actions and changes.
    - SupportTicket: Tracks user-submitted issues or support requests.

➢ Comprehensive Table of Classes and Their Relationships

The Comprehensive Table of Classes and Their Relationships Summary ingests in detail the fundamental components of object-oriented design within the system. It is a table that summarizes the definitions of each class, the key attributes of the class, methodical procedures, access visibility (public/private), and logical relationships with each other.

This is included for several reasons:

***Table 15**:Comprehensive Table of Classes and Their Relationships.*

Class Name	Related Classes	Relationship Type / Description	Key Attributes	Core Methods
User	Learner, Instructor, Administrator, ForumPost, Message, Notification, NotificationSetting, Subscription, Payment, UserActivity, SupportTicket, Conversation	Base class; participates in many interactions across platform	userId, name, email, password, role,phone	login(), logout(), updateProfile()
Learner	Enrollment, Result, Certificate, ForumPost, Message, ProgressTracker	Inherits from User; interacts with courses and assessments	progress, enrolledCourses	enrollInCourse(), viewProgress()

Instructor	Course, Lesson, ForumPost, Message	Inherits from User; creates and manages educational content	createdCourses	createCourse(), uploadLesson()
Administrator	User, Course, Notification, AuditLog	Inherits from User; system-level control	permissions	manageUsers(), sendNotification()
Course	Lesson, Assessment, Enrollment, ForumPost, Certificate, ProgressTracker	Core educational unit; links with learners and instructors	courseId, title, description, status	addLesson(), publish(), archive()
Lesson	Course	Belongs to a Course (Composition)	lessonId, title, content, videoUrl	updateContent(), attachVideo()
Enrollment	Learner, Course	Represents learner enrollment	enrollmentId, learnerId, courseId, status	trackProgress(), completeCourse()
Assessment	Course, Question, Result	Linked to courses and tests learner knowledge	assessmentId, courseId, type	addQuestion(), evaluate()
Question	Assessment, Answer	Part of assessments	questionId, text, type	addAnswer(), validateAnswer()
Answer	Question	Options for questions	answerId, content, isCorrect	—
Result	Learner, Assessment	Stores learner scores	score, feedback	calculateGrade()
Certificate	Learner, Course	Issued upon successful completion	certificateId, issueDate, learnerId	generatePDF(), verify()
ForumPost	User, Course	Course discussions	postId, content, authorId	editPost(), deletePost()
Comment	ForumPost, User	Replies to forum posts	commentId, text, postId	replyToComment()

Message	User, Conversation	Private messaging	messageId, senderId, receiverId, content	sendMessage()
Conversation	Message, User	Threads of messages	conversationId, participants	startConversation(), archiveConversation()
Notification	User	System alerts	notificationId, message, userId	send(), markAsRead()
NotificationSetting	User	Notification preferences	userId, preferences	updatePreferences()
Subscription	User	Access to paid content	subscriptionId, userId, plan	activate(), cancel()
Payment	User, Subscription, Invoice	Handles payments	paymentId, amount, date	process(), refund()
Invoice	Payment	Billing record	invoiceId, paymentId	generateInvoicePDF()
UserActivity	User	Tracks actions	activityId, action, timestamp	logActivity()
ProgressTracker	Learner, Course	Tracks course progress	trackerId, learnerId, courseId	updateProgress(), getProgress()
SystemConfig	—	Global system configuration	key, value	updateSetting()
AuditLog	Administrator	Admin activity logs	logId, action, adminId	recordAction()
SupportTicket	User	Support system	ticketId, userId, issue	submit(), closeTicket()
Token	User	Used for authentication/session management	tokenValue, createdAt, expiresAt, status	generateToken(), validateToken(), revokeToken()
Session	User	Tracks user sessions and device info	sessionId, createdAt, expiresAt, ipAddress	startSession(), endSession(), isValid()

3.4 Sequence Diagrams

➢ Login Sequence Diagram

The following sequence diagram demonstrates the process of logging in to the system. The sequence begins when the user enters the email address and password using the user interface. The LoginController will pass the email address and password to the LoginController, which will run authentication logic through the User class using the login() method.

When the credentials are valid, the system will create an authentication token using the Token class (this could be done, for example, through JSON Web Token). Then, the Session class will create the user session that stores key information such as session id, expiration time and user that is associated with the session.

At the end of the process, the LoginController will respond to the user with the token and the session id, allowing the user to securely use the subsequent application features.

Overall, this diagram demonstrates the interaction between core objects, as well as clearly showing the sequential validation logic and session management within the platform structure.

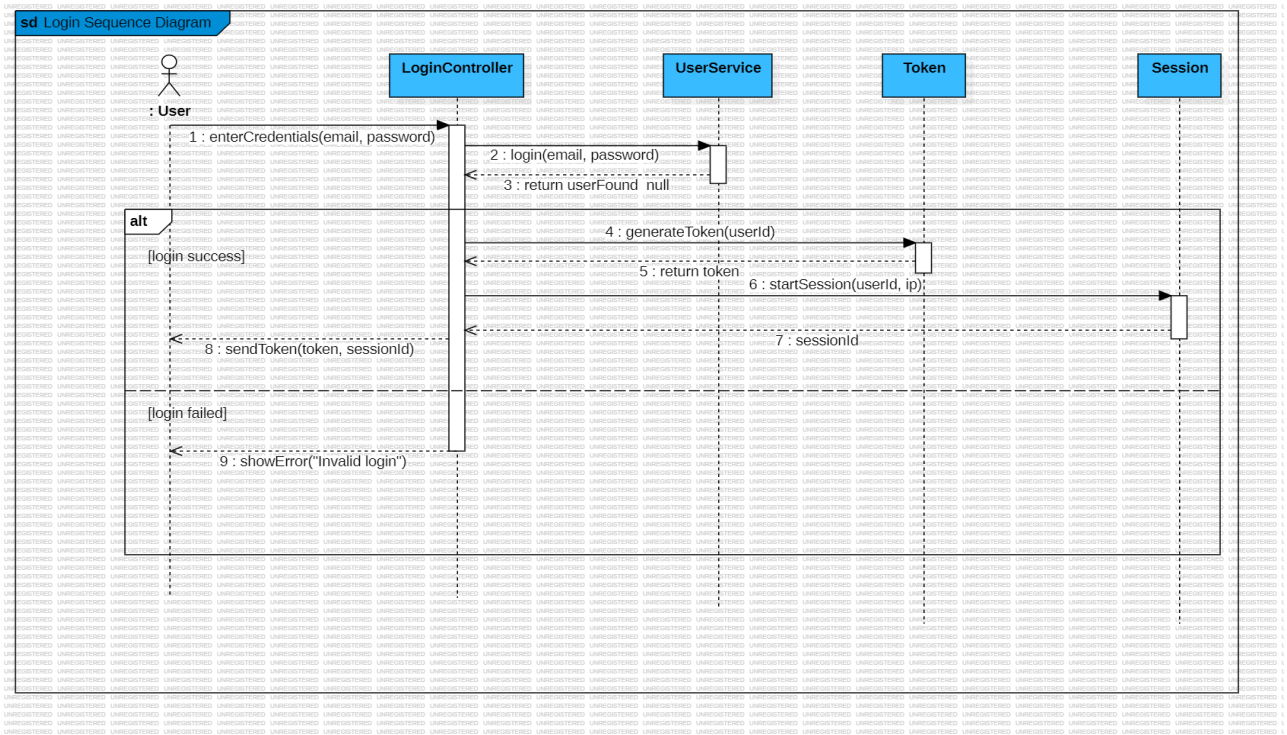

***Figure 15**:Login Sequence Diagram.*

- **Enroll in Course Sequence Diagram**

This sequence diagram demonstrates the steps in a user enrolling a learner (student) into the course on the digital learning platform, starting with a learner selecting a course (taking into account the current open and course enrollment levels). The learner submits the registration request through the user interface, which goes to the CourseController that builds the new Enrollment, which contains the learner ID and course ID.
Once enrolled, a ProgressTracker is created to be linked to the learner and course watching for the completion of the course as updates on their progress will be reported back to provide updated progress over time.
Finally, as evidenced in the diagram, a message is sent back to the learner confirming their enrollment and allowing access to the learning materials via the user's interface.

This diagram depicts how the time-sequence interactions between the core objects can provide detail level about how a user action can be maintained persistently within the system linking to logic for progress tracking.

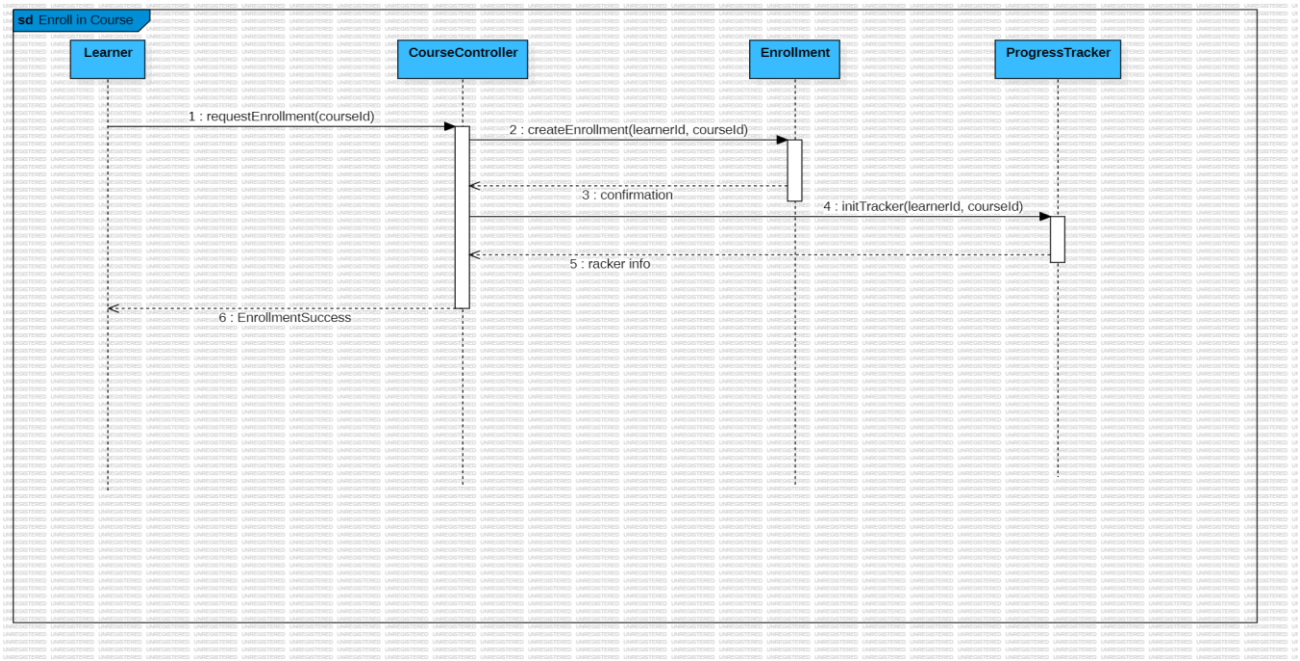

***Figure 16**:Enroll in Course Sequence Diagram.*

- **Take Course and Track Progress Sequence Diagram:**

This sequence diagram demonstrates the actions taken when a learner interacts with course content, and the system updates their progression with respect to their progress percentage in real-time. The process begins when a learner chooses a lesson in a course the learner is enrolled in, and sends a request to the ProgressController.

Upon receiving the request, the controller retrieves information about the course from the Course object (e.g. title, total lessons), gets the chosen lesson's content from the

Lesson object (including the multimedia and text materials), and presents that content to the learner.

Once the content is presented to the learner, the controller updates the learner's corresponding ProgressTracker and updates the progress percentage based on the lessons that the learner completed.

In the end, the learner sees the lesson content, along with their progress indication (percentage).

This diagram illustrates the actions taken to ensure that learnings are accurately and habitually tracked for real-time updates by the system so that the learner develops a personalized and adaptive learning experience.

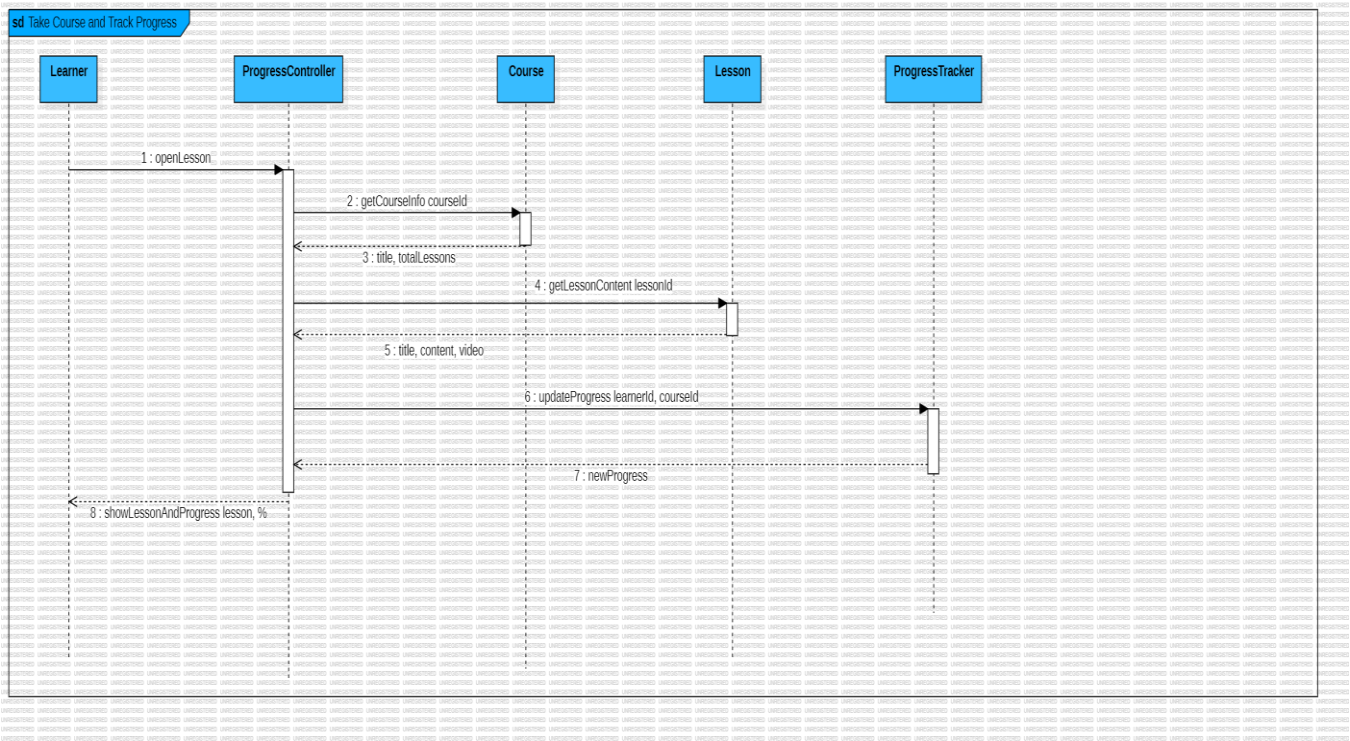

***Figure 17**:Take Course and Track Progress Sequence Diagram.*

- **Take Assessment Sequence Diagram**

This sequence diagram presents the arrangement of how a learner completes an assessment associated with a course. The scenario starts when the learner starts the assessment via request to the AssessmentController.

The AssessmentController will retrieve the overall list of questions from the assessment object, which defines the question identifiers, content, and question types. The learner answers a defined number of questions and the submitted answers are passed on to the Result object to process the learner answers.

The result component will calculate a final score for the learner and feedback based on the answers submitted.
At the end of the interaction, the learner receives the score with feedback comments so they understand their performance.

The diagram provides the overall automated, interactive nature of the assessments being administered in the platform and whether as a learning activity, grading tasks and reporting may be conducted in a seamless manner.

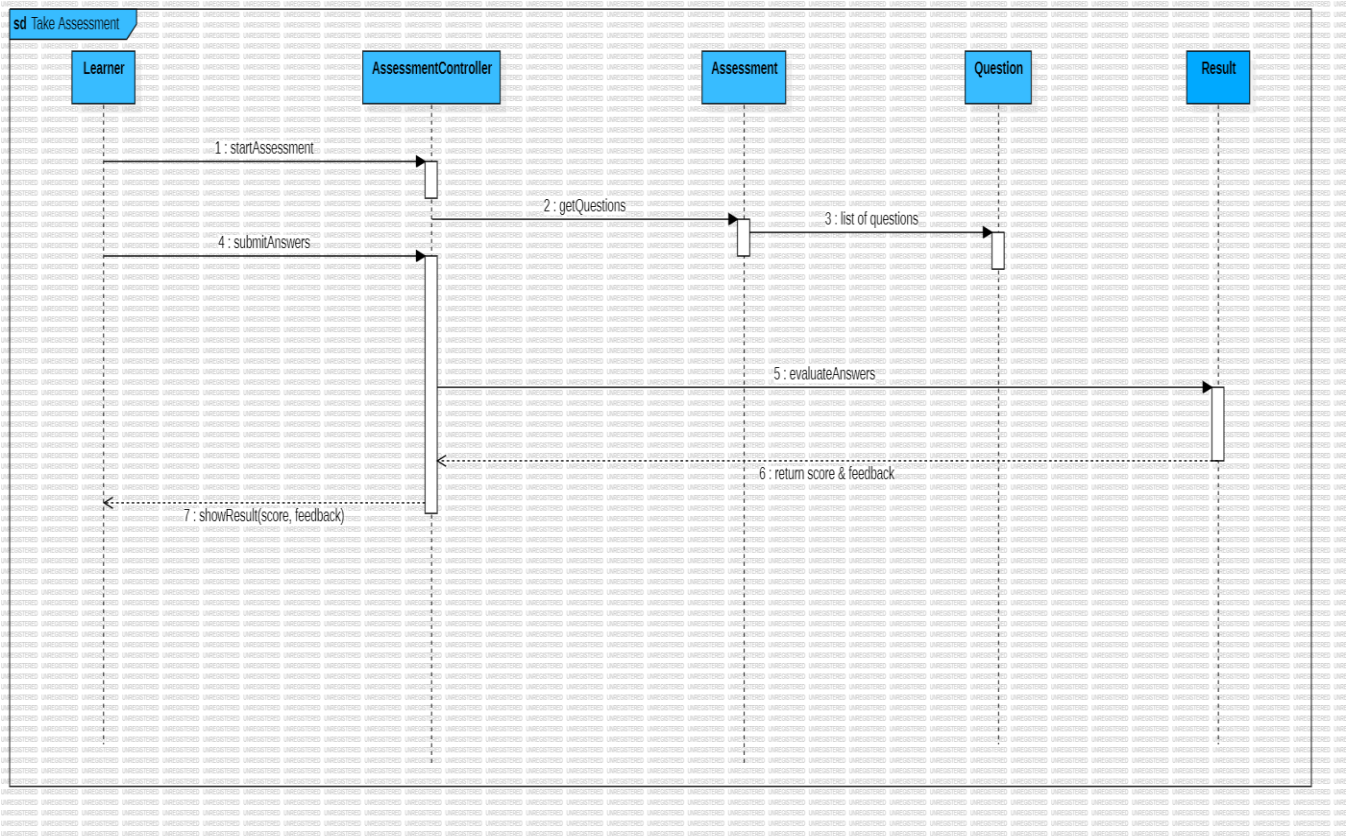

***Figure 18**:Take Assessment Sequence Diagram.*

- **Generate Certificate Sequence Diagram**

This sequence diagram describes how a certificate is created for a learner after they have successfully completed a course. The sequence begins when the learner requests the certificate (if this has been enabled by the instructor), or when the system determines that the learner meets the criteria for a certificate, and the system then initiates a request to the CertificateController.

After being notified, the controller first checks any academic criteria by querying the ProgressTracker to determine the learner's course progress, and the Result object to determine if the learner had passed that assessment (whole course or unit).

If the learner satisfies both requirements (has made progress and attained a passing score), the system then calls the Certificate component to provide a digital certificate of achievement which will be tied to both the learner and the course.

The certificate will be then presented to the learner through the user interface and will be available for display and/or download.

If the criteria are not met for either requirement the learner will be notified accordingly.

The purpose of this sequence diagram is to demonstrate that integrity and the automated (that is, certificates issued based on actual performance) is important in the certificate granting process.

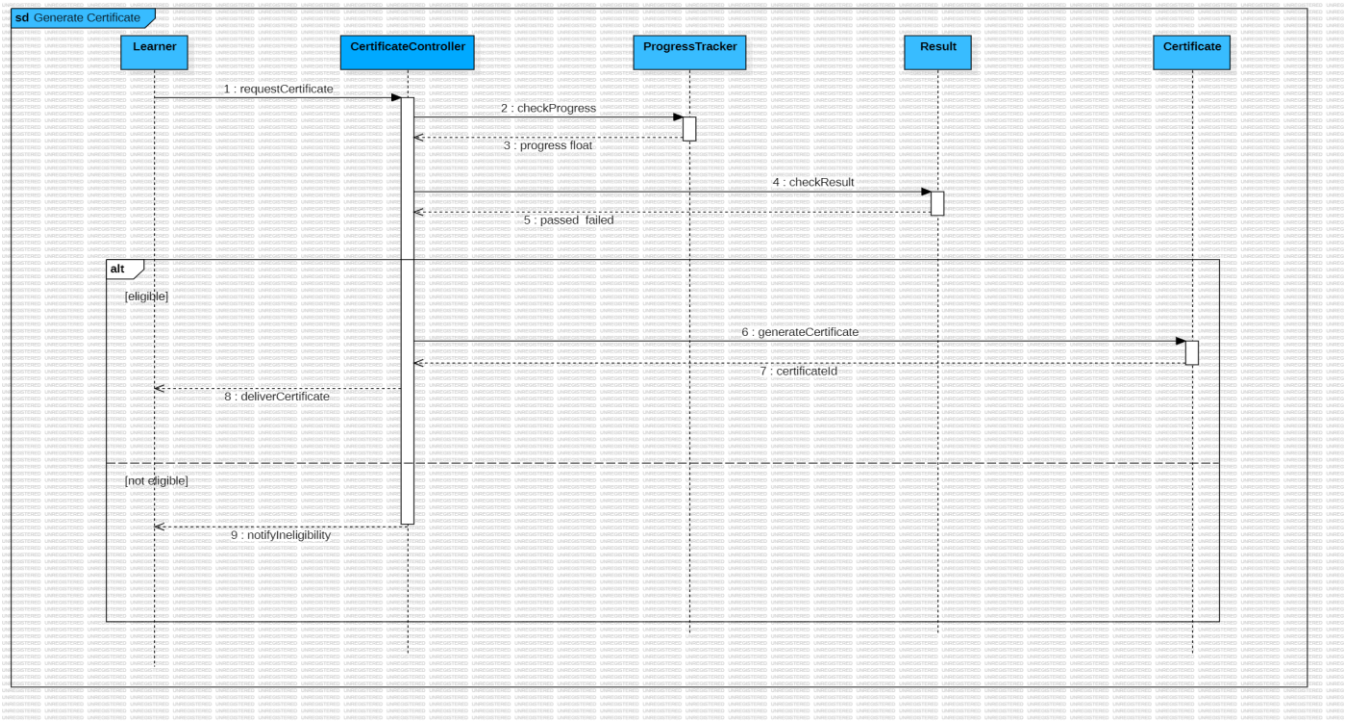

***Figure 19**:Generate Certificate Sequence Diagram.*

- **Create Course Sequence Diagram**

This sequence diagram outlines the instantiation of a course within the platform via an instructor. The interaction commences with the instructor supplying course details and submitting to the CourseController.

The CourseController accepts the instructor's request to create a new course. The controller creates a new Course object, persists the new course to the database (this includes a new, unique id for the new course and all course-related metadata).

If the request is successful, the instructor receives a success message with the course id, and they are invited to, for example, begin adding lessons and other content.

This diagram has laid out the structural mechanism of content creation in the platform, and communication between components of the backend system is under control.

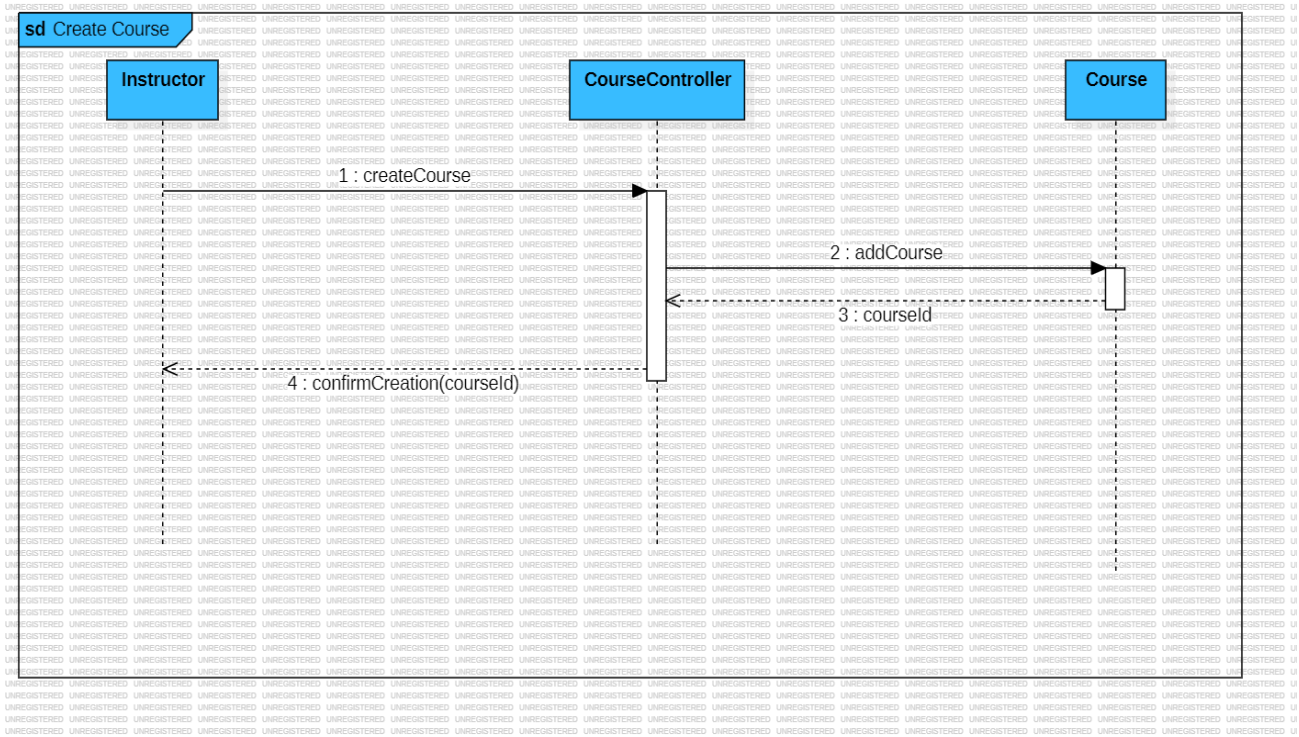

***Figure 20**:Create Course Sequence Diagram.*

- **Upload Lesson Sequence Diagram**

The flowchart shown above describes the process in which an instructor uploads a new lesson to an existing course. It begins when the instructor (or other course administrator) submits a request with lesson information - for example, the title, video URL, and the content text - via the interface. This request is subject to the LessonController.

The controller creates a new Lesson object using the lesson information presented in the request and associates it to the Course with which the lesson is to be associated. At this point, the lesson is registered as part of the course content and becomes available for learners who are enrolled in that course.

After the lesson object has been created successfully, a message is returned to the instructor consisting of a confirmation notification (or the lesson ID).

In summary, this diagram represents the interactive process that is happening and supports the traceable, and event-based functionality of adding educational content about instructors and courses.

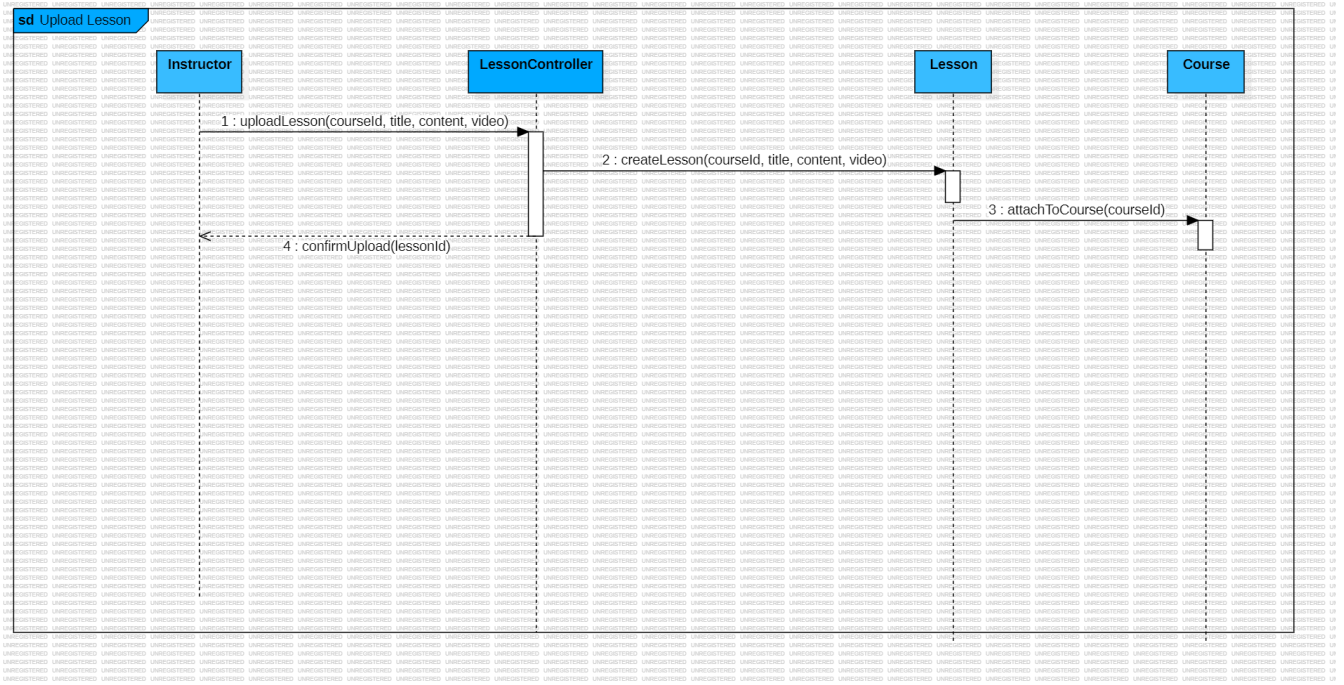

***Figure 21**:Upload Lesson Sequence Diagram.*

- **Make a Payment Sequence Diagram**

This sequence diagram outlines how a user can use the platform to process electronic payments, either for access to a paid course or subscription to a premium learning plan. The process begins when the user sends its payment details (information like the amount and plan or course ID) to the PaymentController.

The controller acts as an intermediary by sending the payment for processing to the Payment component, which creates the transaction and returns a status of success or failure.

If the payment was processed successfully, access is granted to the Subscription object for the user, an electronic Invoice is created and e-mailed to the user along with payment confirmation.

If the payment failed, an appropriate message is sent to the user from the system and no subscription or access to the course is granted.

- **Note:**

In cases where course is a paid course, this payment situation must occur before the "Enroll in Course" sequence, as enrolling cannot happen until payment is completed.

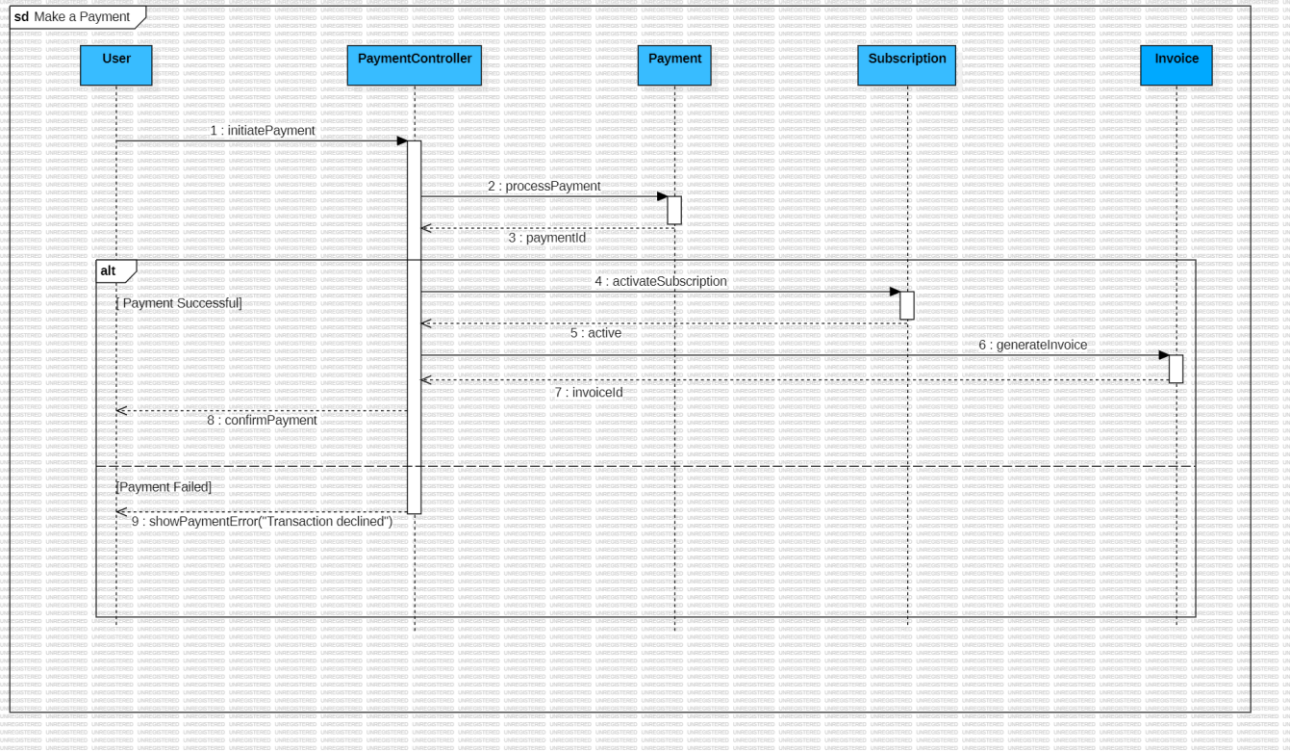

***Figure 22**:Make a Payment Sequence Diagram .*

4. User Interface and User Experience (UI/UX) Design

The aim is to provide an inclusive and intuitive interaction for users, which is especially salient in the case of an Algerian context. Arabic is used as the default interface language, and English will also be accommodated to enhance user accessibility.

On a technical basis, responsive design ensured that sites are responsive to a variety of screen sizes and devices, including smartphones, tablets, and desktop computers. Principles of accessibility integtrated through colour contrasts, text size, and element logic ensure that the sites are usable to users with disabilities.

Culturally, the interface is free of any flashy visual items such as animations and instead, promotes a more simplified visual layout that is aligned with the expectations of the local user population. User journeys are more streamlined by reducing the steps needed to access content, creating more usability and engaging users with the design.

In support of these concepts, we have illustrated interface prototypes along with actual screenshots.

4.1 Include interface prototypes or screenshots

- **Homme page interface**

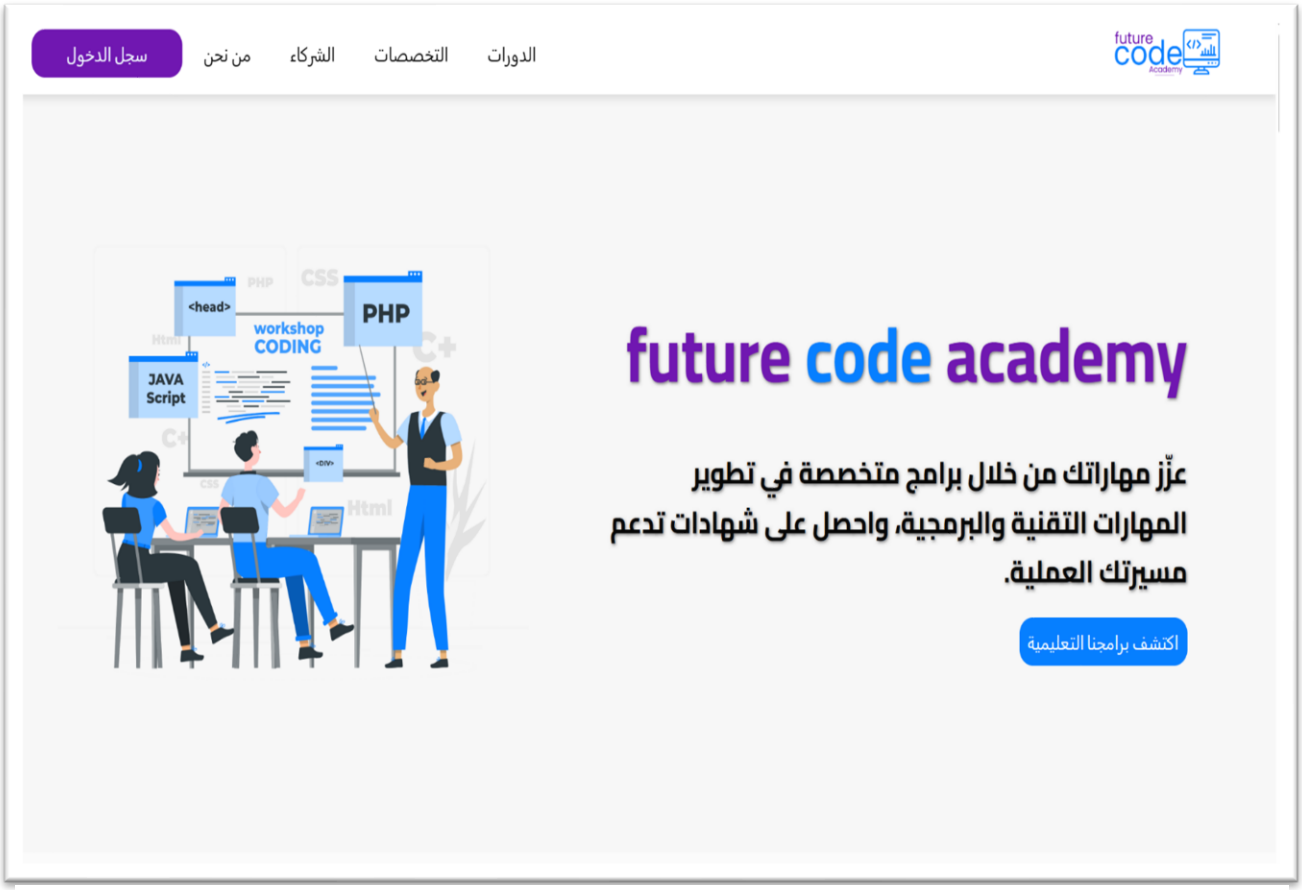

***Figure 23**:Homme page interface*

The homepage of the digital educational platform serves as the primary entry point for users and is designed to be intuitive, informative, and action-oriented. It follows user-centered design principles to ensure that key features and content are accessible at a glance, minimizing the need for deep navigation.

At the top, a navigation bar presents the platform's logo, login and registration buttons, and essential links such as "Courses," "About," and "Home."

Below the navigation, a welcoming banner highlights the platform's purpose with a short introductory message and a prominent call-to-action button, such as "Explore Courses" or "Get Started."

The main body features categorized course previews (e.g., Programming, Design, Networking), each displayed as a card with a thumbnail image, course title, instructor name, and number of enrolled learners.

An additional section promotes the platform's key features—such as progress tracking, certificate issuance, technical support, and interactive learning—accompanied by illustrative icons.

Finally, the footer displays contact information, links to social media, and legal policies including privacy and terms of use.
The homepage plays a vital role in the user experience, offering a professional first impression and guiding the visitor toward immediate engagement without cognitive or technical barriers.

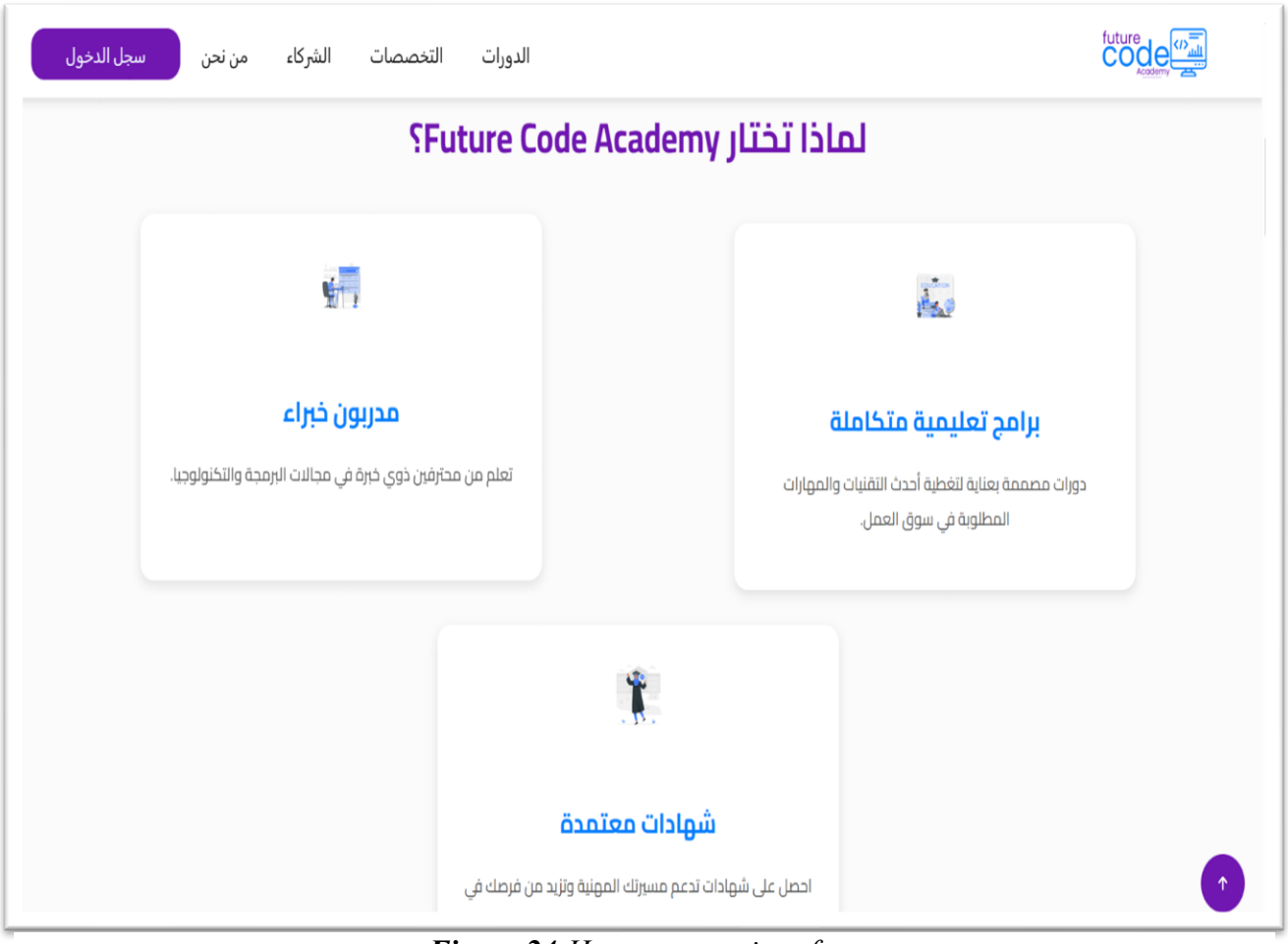

***Figure 24**:Homme page interface*

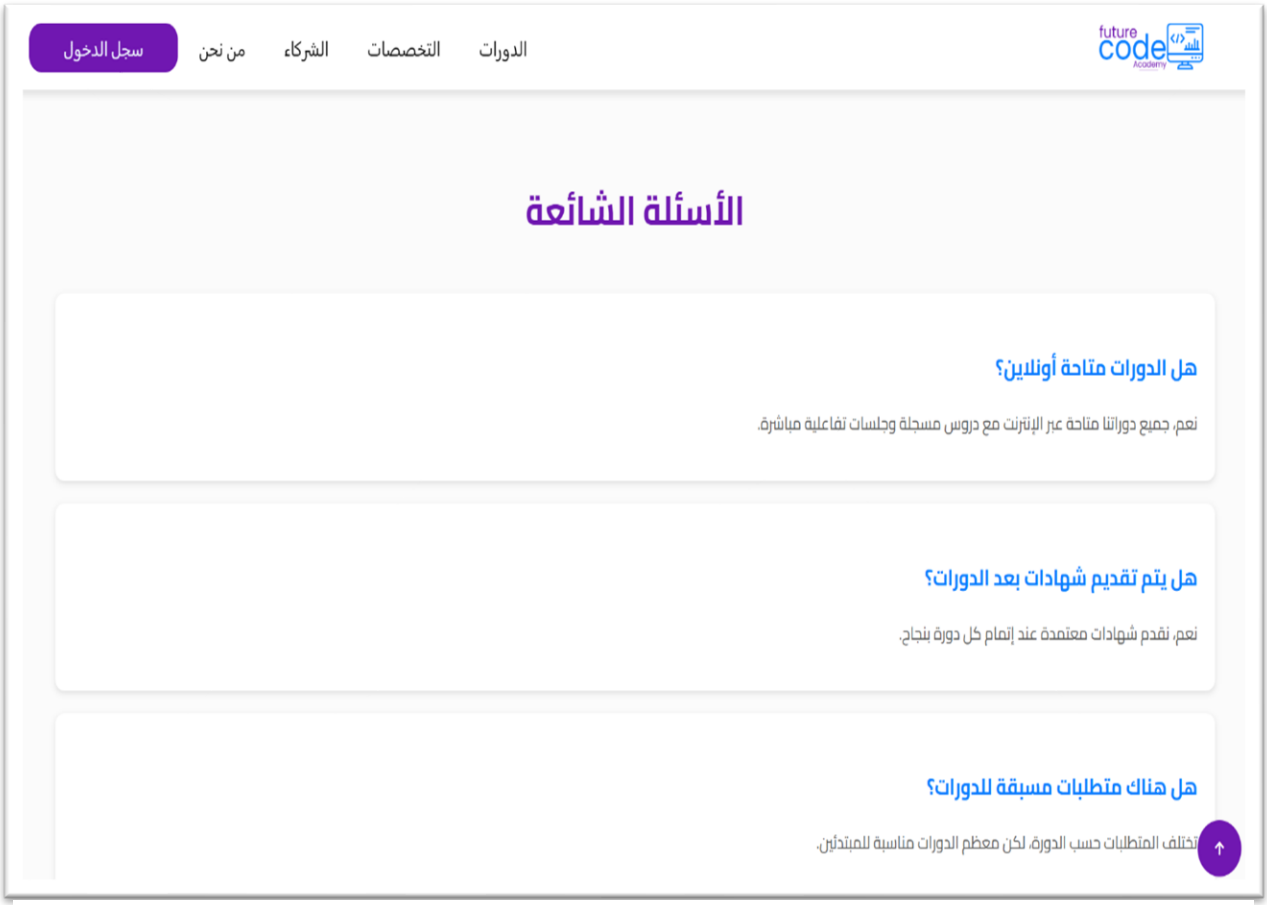

***Figure 25**:Homme page interface*

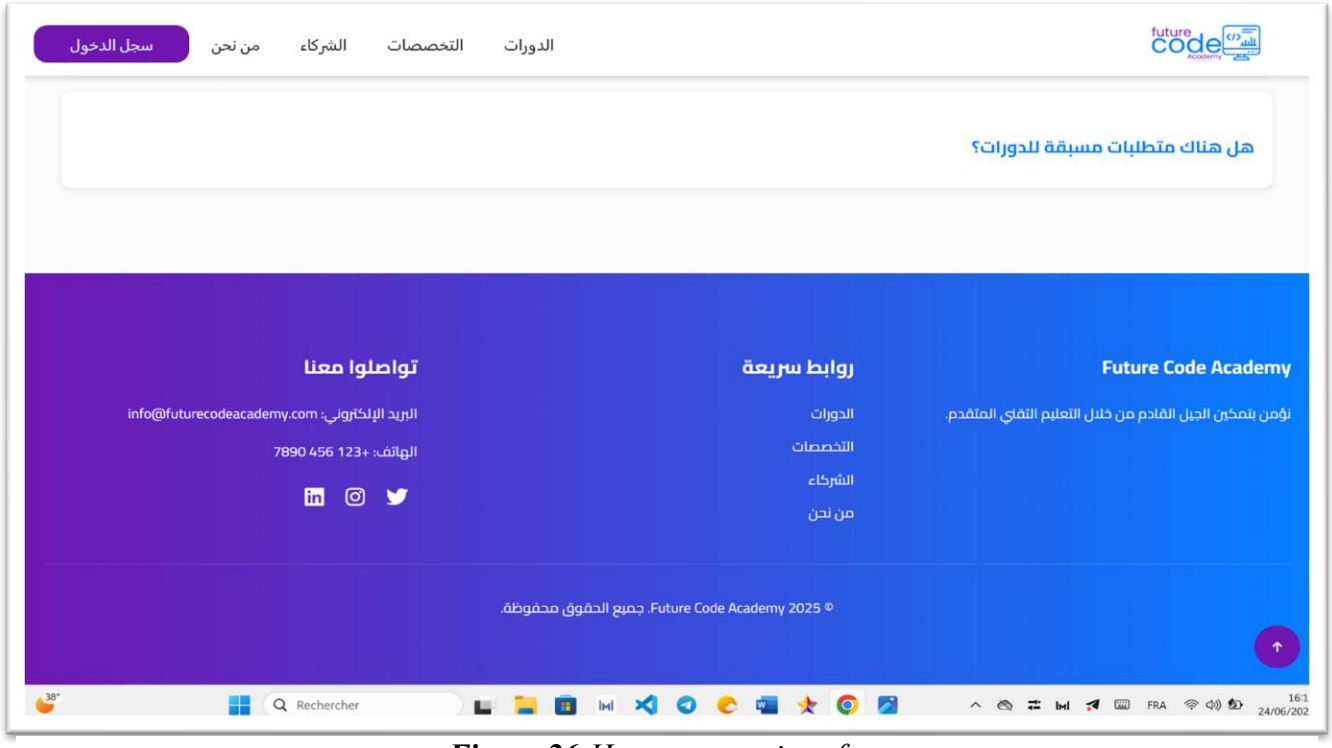

***Figure 26**:Homme page interface*

- **Specializations and courses interface**

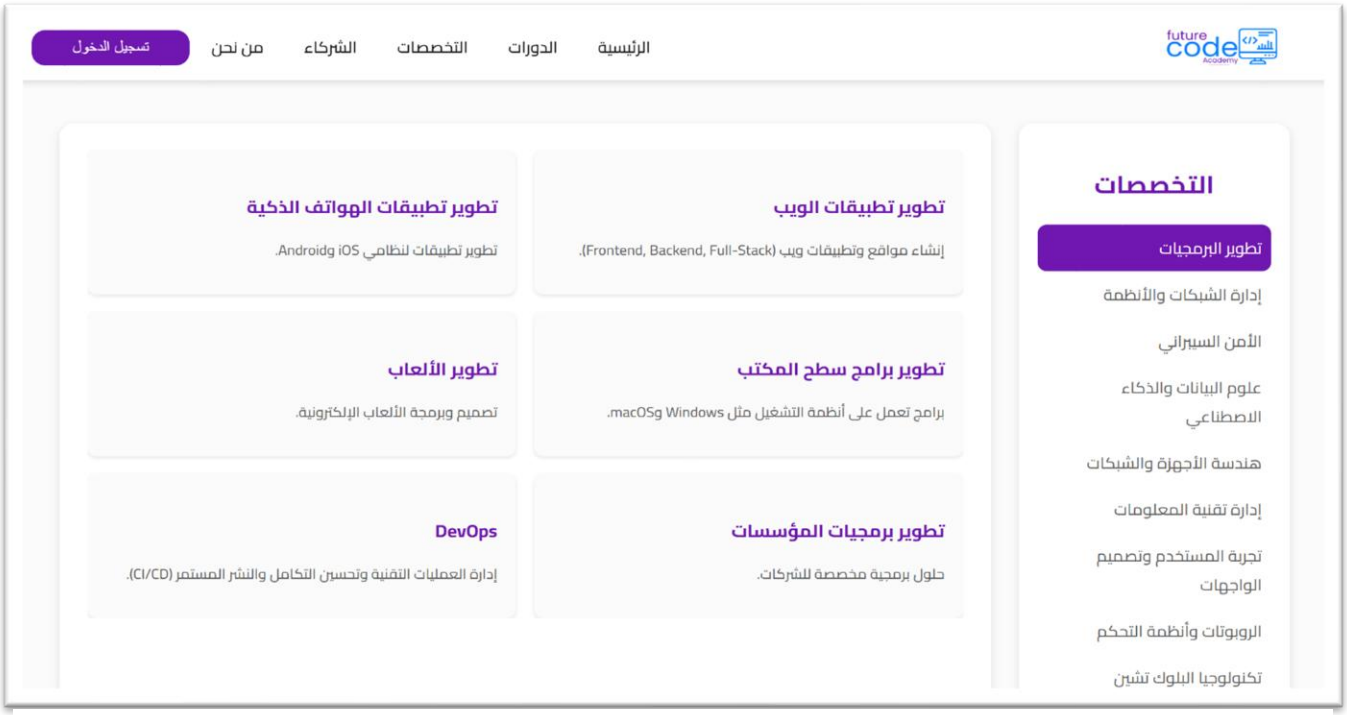

***Figure 27**:Specializations and courses interface*

One of the critical elements of the platform is the Specializations and Courses Interface, which provides users with a structured and categorized view of educational content based learning tracks or subject areas.
After choosing a specialization, the user is taken to another subpage that shows all the courses inside that specialization, commonly displayed in a grid format.
The user is able to filter also by other parameters such as difficulty (beginner, intermediate, advanced) and type of course (video, hands-on, theory, etc.), making it a more personal, and guided browsing experience.

This structure enhances user experience by allowing users to discover content as they intuitively expect, even if they don't know the entire layout of the platform.
In addition, the modular nature of the architecture will lend itself to future specializations, which makes the platform both scalable, and maintains consistency across all future specializations.

- **logIn interface**

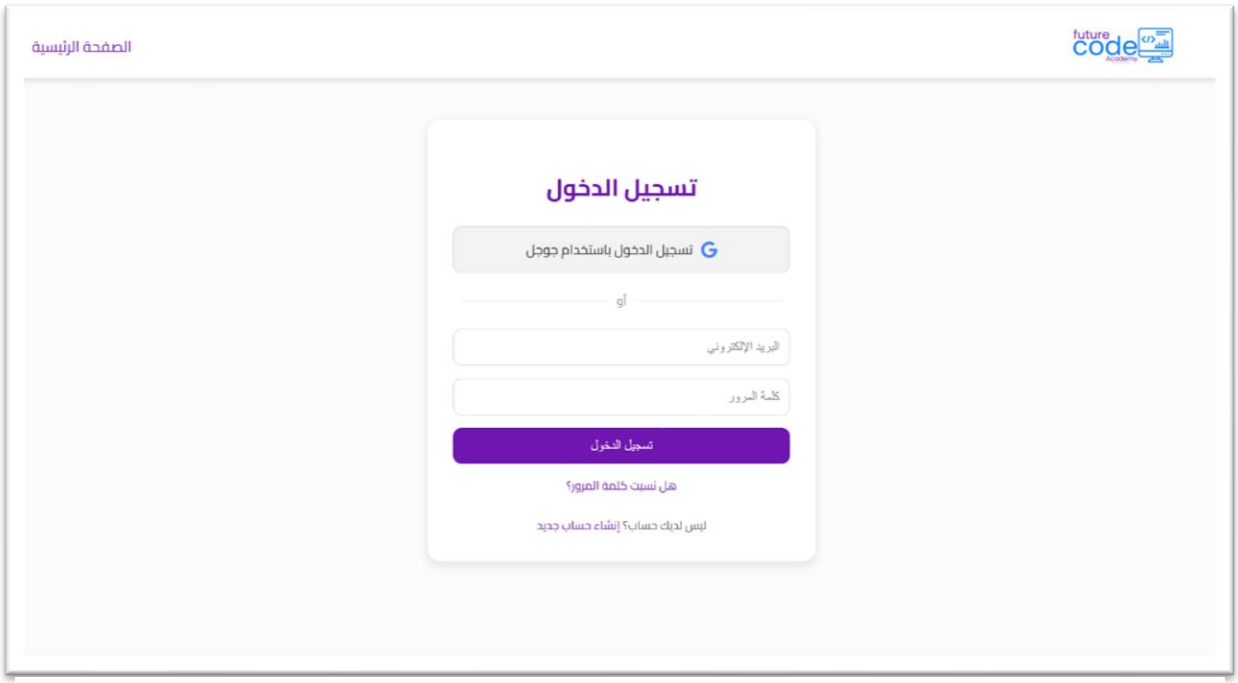

***Figure 28**:LogIn interface.*

The LogIn Interface is the endorsed entry to the digital platform. The design is clean, logical, and user friendly -- all users need to be able to access the platform quickly and easily.

The components of the interface includes two input fields: an input field for the user to enter either their email or username, and an input field for the user to enter

their password, a button labelled "Log In', and links such as "Forgot Password?" and "Create a New Account."

In terms of design, there is clear visual isolation between elements and background; visual anchor points/supports with spacing to help users appropriately. The design will allow for a seamless experience among interface users, including usability among users with mobile phones.
The security portion includes best practices on logic, including password masking/unmasking and client-side verification to avoid incomplete or wrong submissions.

The login interface will provide support for all roles of users (learners, instructors, administrators). Upon successful authentication, each role will be redirected to their respective dashboard.
The login interface has a critical role in successfully achieving safe and seamless access to features in the platform environment.

- **signUp Interface**

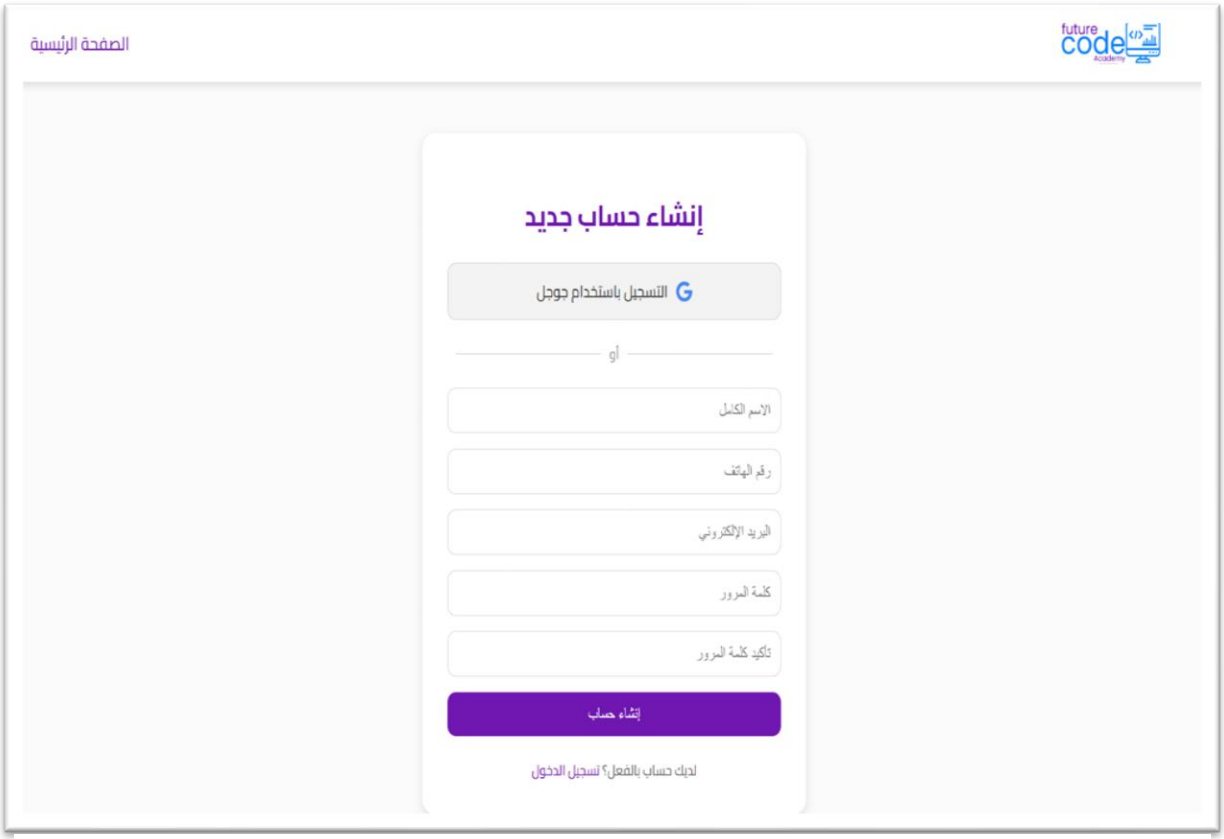

***Figure 29**:SignUp interface.*

The SignUp Interface is the main entry point for new users to create their account on the platform. It is built for ease of use and simplicity to enable friction-free onboarding. This interface has four important input fields.

- Full Name: Used for identification and will show up in user profiles and credentials.
- Phone Number: Used for two-factor authentication or for simple communication, if required.
- Email Address: The main identifier for this account and is used for logging in as well as password recovery.
- Password: protects the account but is subject to validations for length and complexity to make it secured.

The SignUp user interface is built responsively and will work effectively across devices. It allows for real-time validation messages for correcting input mistakes, and even includes password visibility toggles, and contextual tips about the password requirements or existing accounts.

On successful registration, the user will either be redirected to the login interface, or to their personal dashboard based on the system's navigation flow.

➢ **Abut use interface**

***Figure 30**:Abut use interface.*

The About Interface provides an informative overview of the platform's identity, educational mission, target audience, and core value proposition.

This interface is designed to build user trust by clearly presenting the platform's philosophy, methodology, and distinguishing features.

- **Web Development Course interface**

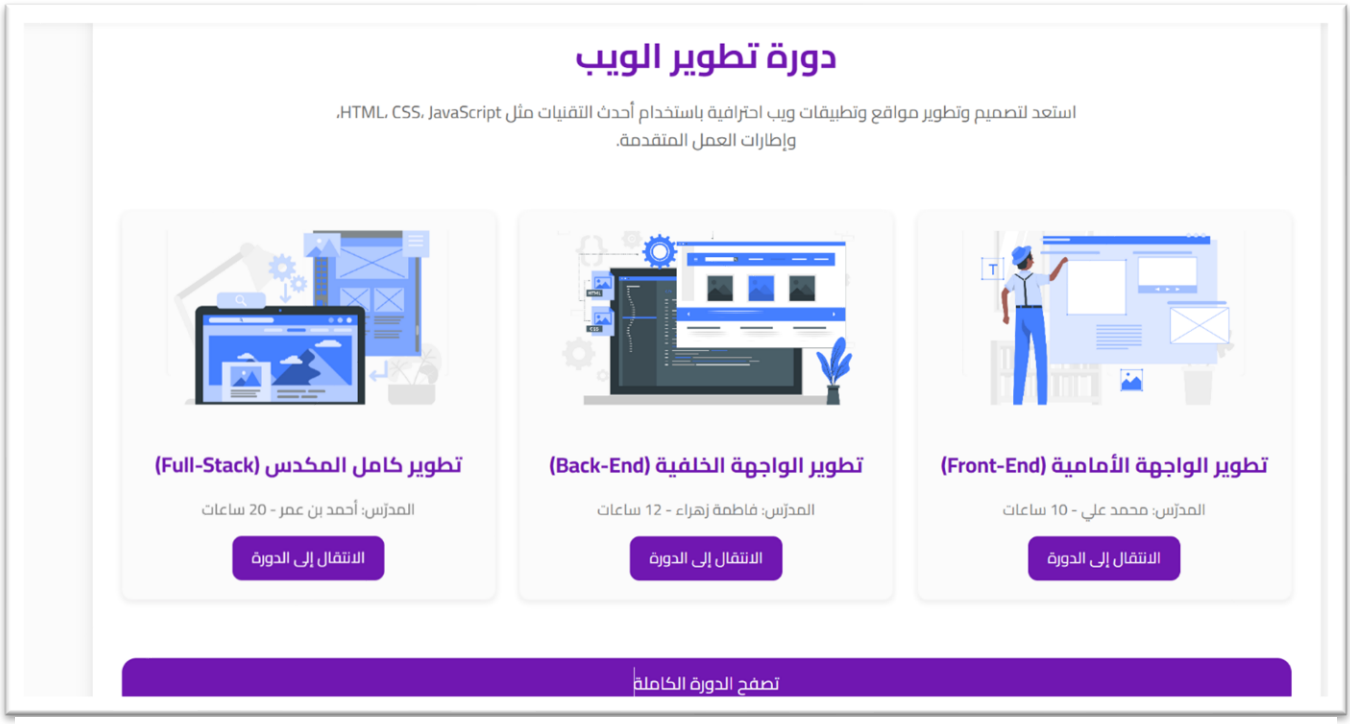

***Figure 31**:Web Development Course.*

The learner accesses the "Software Development" category within the educational specializations interface. Within this specialization, the "Web Development" course is presented as one of the core training paths, which contains content on creating interactive websites and web applications in practical spaces.

The displayed course card provides the course title, a brief description of the course, and thematic thumbnail image, and the number of users enrolled.

- **Browse courses interface**

***Figure 32**:Browse courses interface.*

Browse courses, where students select a front-end development course, navigate to the course to browse its contents, and enroll in it.

- **Payment and subscription interface**

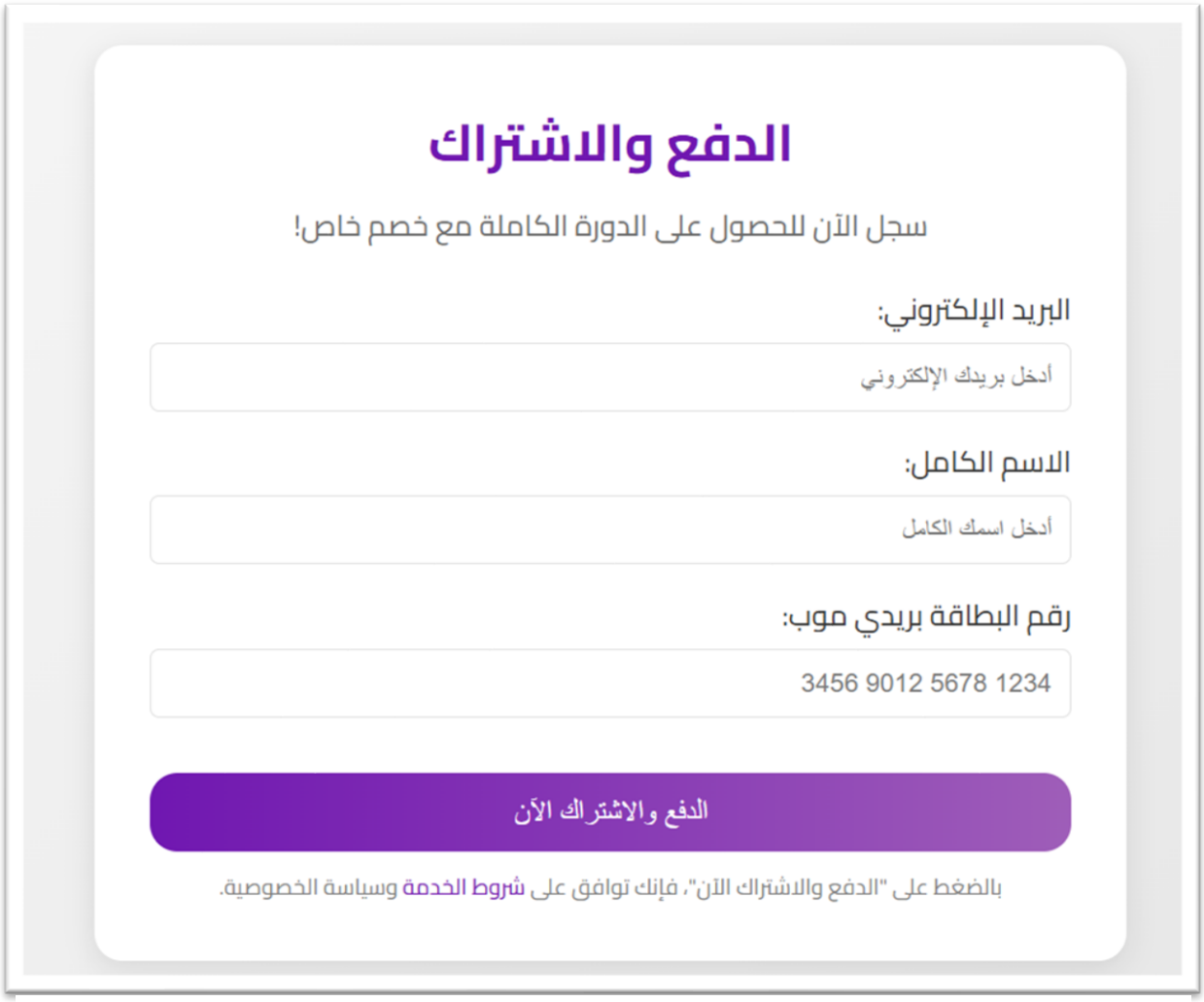

***Figure 33**:Payment and subscription interface.*

When the teacher registers for the course, this window appears for them to complete the rest of the procedures, after which they can receive the lessons.

- **Take lessons interface**

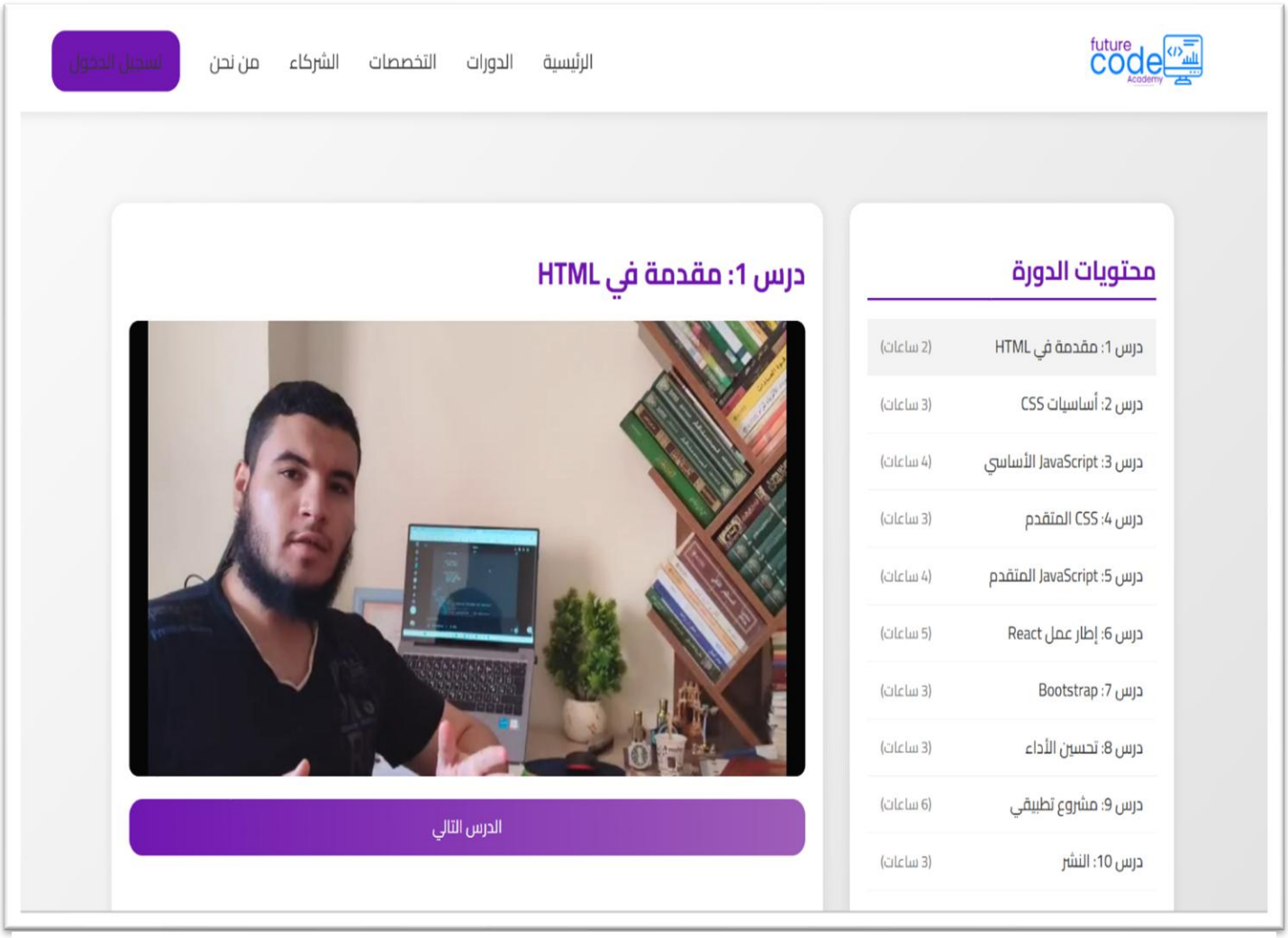

***Figure 34**:Take lessons interface.*

Lesson display interface where learners can follow their lessons.

- **Exame interface**

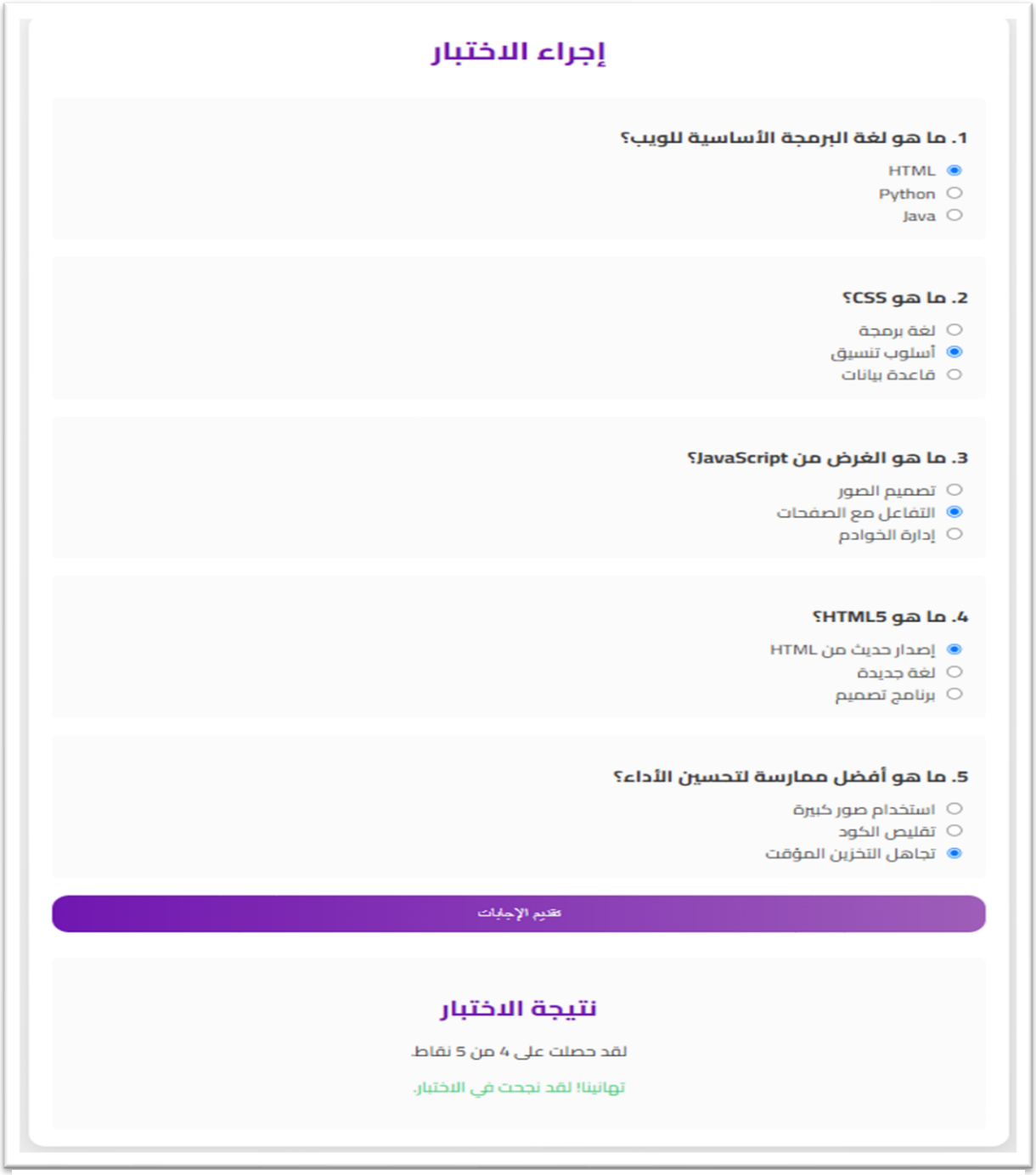

***Figure 35**: Exam interface.*

Upon completion of the lessons, a test is conducted and the results are displayed.

- **Issuance of the certificate by the trainer**

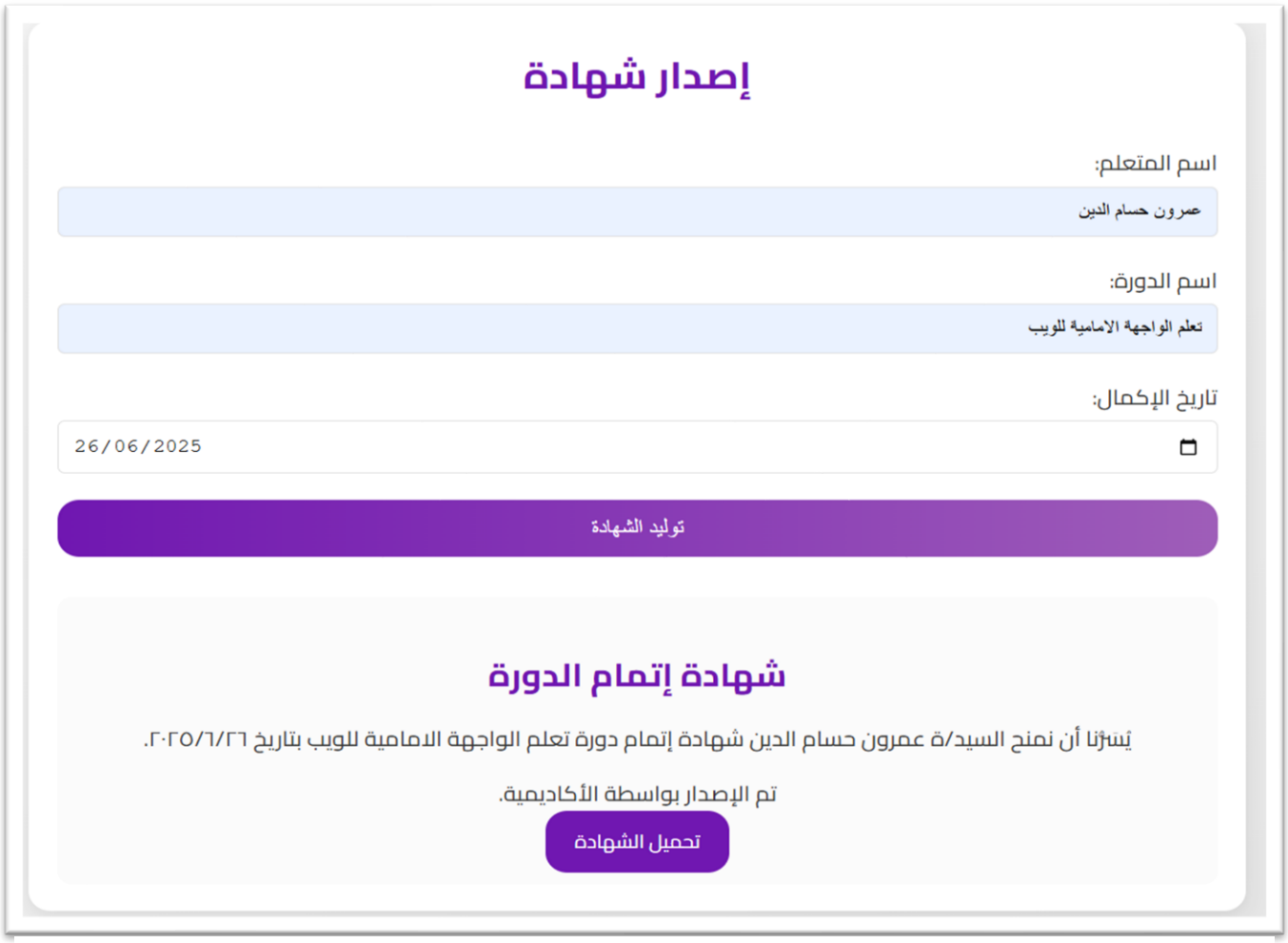

***Figure 36**:Issuance of the certificate by the trainer.*

The instructor records student information so that they can receive and view their certificates.

- **Upload lessons interface**

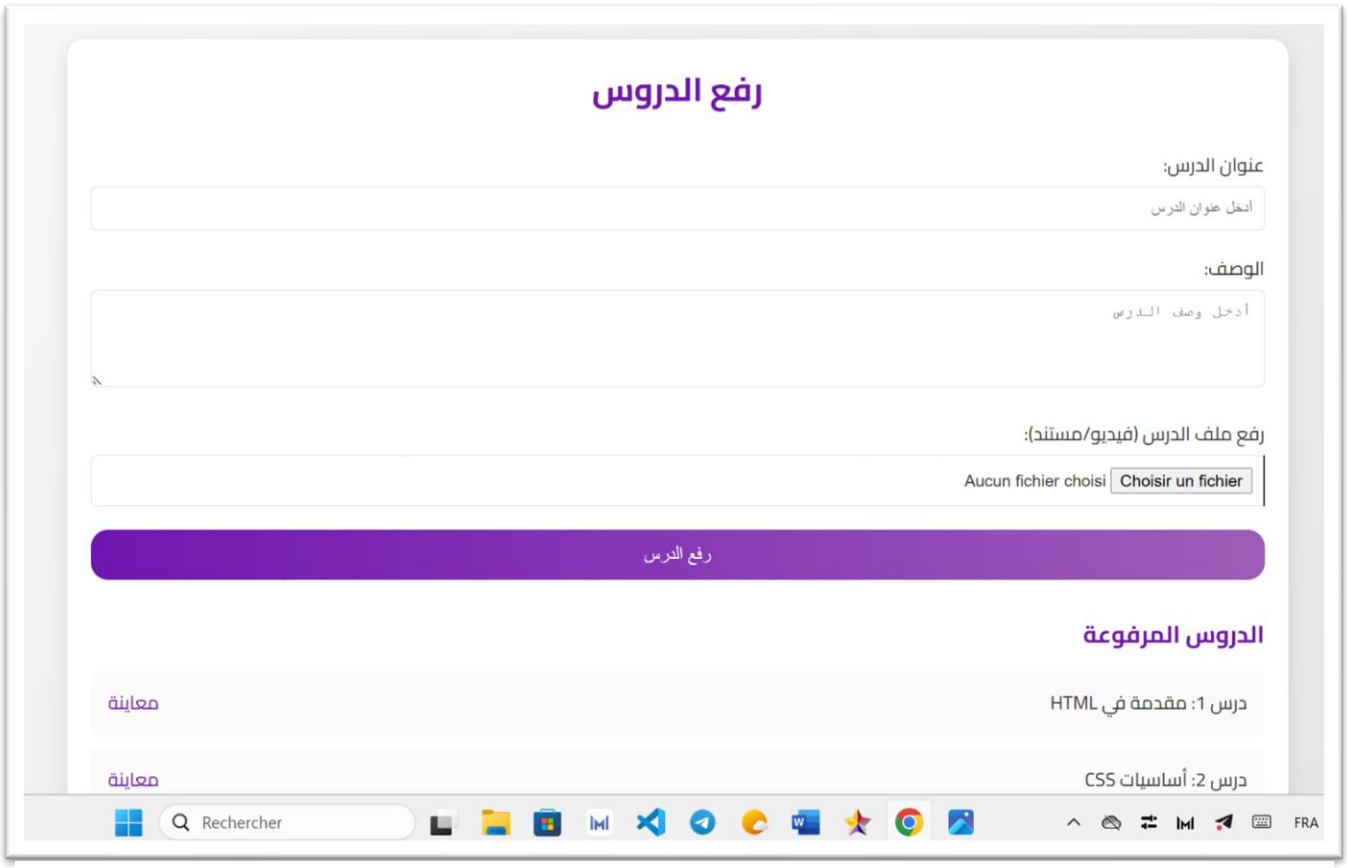

***Figure 37**: Upload lessons interface.*

The teacher uploads lessons and learning resources.

5. Design Validation

Design validation is an important stage to confirm that the proposed design corresponds to the system requirements specified in the analysis phase.
The aim of this validation is to verify that the architecture diagrams (UML) and the User Interface (UI) designs and the general architecture of the system are consistent with the specified functional and non-functional requirements.

Validation Methods

Various systematic approaches were used to confirm the correctness of the design, including:
- Matching between user requirements and implemented functionality in text, and
- Comparing design elements versus defined Use Cases, and
- Checking the database structure versus the required entities.

Every functional requirement was traced to a design element (interface, diagram, class, or method) to determine that all requirements were met.

Tools and Review Steps

- The employment of traceability matrices to connect expectations to design elements
- Structural review of UML diagrams with software such as StarUML
- Inspection of interfaces with prototypes and wireframes against the expected user scenarios
- Complete internal peer reviews to assess the design against best practices in digital educational environments.

Preliminary Validation Results
- The validation confirmed that the current design satisfied over 90% of the main functional requirements.
- There are a few small gaps with respect to edge cases (e.g., payment failure, incomplete assessments), which will be closed via the development process.
- The user interfaces were validated against the UX design expectations for Algerian users (language, clarity, and simplicity).
- The structural diagrams (Class, Sequence, Use Case) show alignment with the outcome of the system scenarios from requirements.

These findings verifies that the design provides a solid and reliable foundation for development, so it is appropriate to proceed to the implementation stage.

6. Implementation Planning

The implementation phase of the platform used a clear set of tools, technologies, and methodological principles to guide the steps to deliver the platform in a 'standardized' manner to facilitate consistency, maintainability, and performance.

The front-end development of the platform was constructed using core web technologies of HTML, CSS, and Vanilla JavaScript, chosen for their light-weight performance, quick rendering, and because we would have direct control of the behavior of the interface without the overhead of using a larger framework.

The back-end logic was constructed using Node.js, which provides asynchronous, event-driven logic suitable for real-time educational platforms. MySQL was chosen for the back-end relational database component because it provides excellent speed, flexibility, and control when working with structured data - i.e. users, courses, assessments, and certificates.

The development environment was focused around Visual Studio Code (VS Code), which gave us greater flexibility with its wealth of extensions and live preview features.

For project management and design structure, we adopted the Waterfall model to provide a linear workflow of development, which was suited to this project due to the academic nature and structured delivery. Similarly, throughout the system design, we made use of modeling tools such as StarUML to capture UML diagrams, and Miro as an online collaborative design board.

The platform has been deployed to a hosting environment as a prototype version to be available for testing and demonstration.

A folder structure was implemented to improve code maintainability; separating out routes, controllers, services, views, and database models was integral. First and foremost, clean code principles were employed as follows; providing meaningful names to files/separation of functionality into modules/creating functions that have one task/using comments in the discreation of readability and maintainable code.

An integration strategy that focused on getting the platform functional before investigating the interface was used; that is, developing the small parts (i.e., login, enrollment, assessment modules) separately first, testing them, then providing some more or less structure by integrating those parts into the 'main' system, step by step. Thus, improving our ability to identify, troubleshoot and iterate on features/functionality, without the risk of blowing up the entire system as we developed it as modules.

7. Planned System Testing and Deployment

The testing and deployment phase is scheduled to take place once the main development of the platform is finalized. Since the current version is still under construction, formal testing procedures and full deployment have not yet been executed. However, a clear plan has been established for these steps.

7.1 Planned Testing Activities

The system will be subjected to manual testing to confirm all major features (user registration, logging in, enrolling in courses, browsing lessons, completing assessments, communicating via messaging, and creating certificates), and these will all be assessed individually, followed by subsequent integration tests for interoperability.
Tools used to identify and fix any issues will include VS Code (with console output), MySQL Workbench, and the browsers developer tools. In future iterations there may also be automated unit tests with JavaScript testing libraries.

7.2 Deployment Strategy

Once local testing has been completed, the platform will be deployed on a public hosting site as an operational prototype.
The backend (Node.js) and the database (MySQL) will be hosted online, and the system will be available for demonstration, validation, and feedback from people using the system.

7.3 Future Work

Following deployment, feedback from users and supervisors will be used to improve functionality, fix bugs, and extend features before considering a final release version.

8. Conclusion

This chapter outlined the detailed system design of the educational platform, essentially connecting the abstract design architecture with the concrete. Through various representations and user interfaces, the chapter showed how the functional and non-functional requirements of the system resulting in both technical components, the behaviour of interactions, and the visual elements.

By employing UML diagrams such as use case, class, and sequence diagrams it was easier to illustrate the structure of the system, the way in which users will interact with it, and how it will behave over time. In addition, the user interface ensured that the design adhered to principles of cultural usability, clarity and readability for learners in Algeria.
The chapter also discussed the tools, technologies, coding standards, and approaches to integrations in order to inform the impending implementation of the educational platform; while the platform was still under development, it also established a road map of starting a process for validation and deployment, with the goal of initiating a test and iteration process in repeated phases.

The design provided in this chapter, establishes a substantially strong and scalable basis for bringing the new educational platform to life and ensuring it remains responsive to the needs of its learners and sustain technical aspirations.

General Conclusion

Digital education an area that has developed rapidly in recent years, particularly due to the COVID-19 pandemic has transformed education globally. More importantly, digital education has increased the desire and requirement for digital mediums to promote remote education and for the teaching of more advanced technical skills, programming skills, and more importantly, it has fostered a higher demand for these skills in many industries. The African context is significant because there is a developing interest in information technology (IT) and there is also a gap in the quality and accessibility of quality learning resources in an Algerian context.

This thesis has attempted to fill the gap by designing and proposing a professional digital academy, a fully Algerian one specializing in programming and artificial intelligence and IT training activities. The thesis project took a methodological approach, from the beginning contextual analysis of the current situation, to its final specifications of the system design. Methodologically the project took an approach where the technological mechanisms were blended with pedagogical and socio-cultural aspects of the digital academy's design. The project proceeded by carefully analyzing the context and reviewing extensive literature and conducting benchmarking of international, regional and local digital learning platforms, to better understand what is currently available and where the challenges are. This level of analysis helped to understand the more serious issues embedded in digital education, such as poorly organized content-delivery, noninteractivity, insecure payment facilities, and low levels of completing courses due to the distractions of social media.

To address these challenges, a full set of functional/non-functional requirements was elicited with a strong focus on contextualized adaptation to the unique Algerian infrastructure, language and cultural diversity, and market requirements. The proposed design of the platform includes a fully-fledged learning management system (LMS), interaction components like a live coding exercise and self-evaluation questionnaire, community support facilities like forums and helpdesks, and a scalable software architecture to support strong availability and secure access.

Moreover, this dissertation demonstrated the potential of successfully connecting digital learning initiatives to national strategies for economic diversification and workforce development. The community platform potentially offers viable proposition for not only educating new developers and IT resources but also enabling a generation of emerging developers and IT resources which connects many of the changes to Algeria's intended vision for digital transformation.

The value of this project resides not simply in the technical merit, but the potential impact it has on society. It proposes an inclusive and future-ready education framework that helps students from different backgrounds and assists in closing the digital divide, allowing Algerian youth to better prepare and assist them in living and working in the digital economy.

In conclusion, the proposed digital academy is a realistic and inventive option that respects academic integrity, technical authenticity and situational awareness. It aims to represent a sustainable way of increasing educational reform and developing technology in Algeria, and could serve as a reference point for future developments that want to improve

and localize digital learning opportunities in the region. Future work may include the practicality of implementing the platform, including user testing and multiple iterations.

Bibliography

[1] SMOWL, "What is digital education? Definition, keys and examples," 2023,May 23. [Online]. Available: https://smowl.net/en/blog/digital-education/.

[2] iSpring, "e-learning platforms," 2024,September 19. [Online]. Available: https://www.ispring.ae/blog/-منصات-التعلم-الإلكتروني.

[3] Cpointkw, «Integrated digital education and its importance in the modern era,» 2025,January 2. [En ligne]. Available: https://cpointkw.com/%D8%A7%D9%84%D8%AA%D8%B9%D9%84%D9%8A%D9%85-%D8%A7%D9%84%D8%B1%D9%82%D9%85%D9%8A-2/.

[4] E. W. Association, "History and background: Digital learning," 2021, November 9. [Online]. Available: https://ewa.org/issues/retraining/history-and-background-digital-learning.

[5] Gostudion, «Six types of online learning platforms. Originally published on ExtensionEngine.com. Most recently updated October 18, 2024. Retrieved from,» 2018, January 24. [En ligne]. Available: https://gostudion.com/six-types-of-online-learning-platforms/.

[6] D2L, «The advantages of digital education,» 2022, April 1. [En ligne]. Available: https://www.d2l.com/en-eu/blog/advantages-of-digital-education/.

[7] C. Staff, «What is Coursera?,» 2025, April 18. [En ligne]. Available: https://www.coursera.org/articles/what-is-coursera.

[8] D. Magazine, «Udemy: A comprehensive guide,» 2024, April. [En ligne]. Available: https://dotcommagazine.com/2024/04/udemy-a-comprehensive-guide/.

[9] edX, «Free online courses from edX,» [En ligne]. Available: . https://www.edx.org/school/edx.

[10] Edraak, «About us,» [En ligne]. Available: https://www.edraak.org/en/about-us/.

[11] Barmej, «About Barmej,» [En ligne]. Available: https://www.barmej.com/%D8%B9%D9%86-%D8%A8%D8%B1%D9%85%D8%AC/%D8%A7%D9%84%D8%B5%D8%AD%D8%A7%D9%81%D8%A9/.

[12] Almdrasa, «About Almdrasa,» [En ligne]. Available: https://almdrasa.com/.

[13] Rwaq, «About Rwaq».

[14] EduTime, «About EduTime,» [En ligne]. Available: https://edutime.click.

[15] D. i/o, «About DzCode i/o,» [En ligne]. Available: https://www.dzcode.io/ar/.

[16] GOMYCODE, «Home,» [En ligne]. Available: https://gomycode.com/dz/.

[17] R. Academy. [En ligne]. Available: https://www.facebook.com/risingacademydz/.

[18] M. Saleh, «Designing distance learning courses in light of learning theories. Educational Technology Portal,» 2020. [En ligne]. Available: https://drgawdat.edutech-portal.net/archives/15541.

[19] H. Derrar, «A Rational Analysis of the 2024 ITU Report. LinkedIn,» [En ligne]. Available: https://www.linkedin.com/pulse/icts-algeria-rational-analysis-2024-itu-report-hacene-derrar-9qzre.

[20] OnlyOffice, "The most in-demand IT skills in 2025: A comprehensive guide," 20 February 2025. [Online]. Available: https://www.onlyoffice.com/blog/ar/2025/02/it-skills-for-resume.

[21] TawdifDZ, «Employment in Algeria 2025 | A comprehensive guide to benefiting from the employment platform,» 5 December 2024. [En ligne]. Available: https://tawdifdz.com/tawdif-algeria-job-market/.

[22] S. o. S. E. i. Algeria, «Remote working insights,» 2024. [En ligne]. Available: https://state-of-algeria.dev/docs/insights/remote-working/.

[23] CERIST, «Technical and technological education in Algeria,» 2022. [En ligne]. Available: https://asjp.cerist.dz/en/article/182755.

[24] C. Education, «The most attractive technical specializations for Algerian students in Malaysia in 2025,» 22 May 2025. [En ligne]. Available: https://casbaheducation.com/%D8%A7%D9%84%D8%AA%D8%AE%D8%B5%D8%B5%D8%A7%D8%AA-%D8%A7%D9%84%D8%AA%D9%82%D9%86%D9%8A%D8%A9-%D9%85%D8%A7%D9%84%D9%8A%D8%B2%D9%8A%D8%A7-2025/.

[25] F. Z. &. B. N. Benahmed, «Digital transformation in Algeria: Reality and challenges – A case study. Algerian Scientific Journal Platform,» 2025. [En ligne]. Available: https://asjp.cerist.dz/en/downArticle/175/15/1/264060.

[26] Almostathmir, «E-learning in Algeria: Between challenges and reality,» 2023. [En ligne]. Available: https://almostathmir.dz/%D8%A7%D9%84%D8%AA%D8%B9%D9%84%D9%8A%D9%85-

%D8%A7%D9%84%D8%A7%D9%84%D9%83%D8%AA%D8%B1%D9%88%D9%86%D9%8A-%D9%81%D9%8A-%D8%A7%D9%84%D8%AC%D8%B2%D8%A7%D8%A6%D8%B1-%D8%A8%D9%8A%D9%86-%D8%A7%D9%84%D8%AA/

[27] N. C. f. D. Transformation, «National digital transformation strategy in Algeria,» 2023. [En ligne]. Available: https://hcn.dz/SNTN-Ar.pdf

[28] U. o. Relizane, «National forum on the reality of digital education and distance learning in Algerian universities,» 2023. [En ligne]. Available: https://univ-relizane.dz/%D9%85%D9%84%D8%AA%D9%81%D9%89-%D9%88%D8%B7%D9%86%D9%8A-%D8%AD%D9%88%D9%84%D9%88%D8%A7%D9%82%D8%B9-%D8%A7%D9%84%D8%AA%D8%B9%D9%84%D9%8A%D9%85-%D8%A7%D9%84%D8%B1%D9%82%D9%85%D9%8A-%D9%88%D8%A7%D9%84/

[29] D. Events, «National forum on the reality of digital education and distance learning in Algerian universities,» 2023. [En ligne]. Available: https://www.diae.events/events/138515

[30] M. A. &. B. A. Zayekh, «Reality and challenges of digital education in Algeria during the Covid-19 pandemic. Journal of Economic Problem and Development,» 2022. [En ligne]. Available: https://asjp.cerist.dz/en/article/194479

[31] I. Developer, «The Waterfall model: Advantages, disadvantages, and when you should use it,» 23 April 2019. [En ligne]. Available: . https://developer.ibm.com/articles/waterfall-model-advantages-disadvantages/

[32] G. R. J. &. J. I. Booch, «The Unified Modeling Language User Guide (2nd ed.). Addison-Wesley,» 2005. [En ligne]. Available: https://patologia.com.mx/informatica/uug.pdf

Appendix

الجمهورية الجزائرية الديمقراطية الشعبية
وزارة التعليم العالي والبحث العلمي
جامعة محمد بوضياف المسيلة
حاضنة الأعمال الجامعية

ملحق مذكرة تخرج

للحصول على شهادة جامعية ـ مؤسسة ناشئة

في اطار القرار الوزاري 1275

أكاديمية جزائرية رقمية متخصصة في تعليم البرمجة و الذكاء الاصطناعي و مجالات تكنولوجيا المعلومات

السنة الجامعية : 2025/2024

بطاقة معلومات حول فريق الاشراف وفريق العمل

1- فريق الاشراف:

فريق الاشراف	
المشرف الرئيسي (01): أ.د أخروف سمير	**التخصص:** اعلام الي
المشرف الرئيسي (02): د.أحمد الجربي	**التخصص:** اقتصاد

2- فريق العمل:

فريق المشروع	التخصص	الكلية
عمرون حسام الدين	نظم المعلومات و هندسة البرمجيات SIGL	كلية الرياضيات و الاعلام الالي

شهادة توطين مشروع مبتكر ضمن القرار 008

الجمهورية الجزائرية الديمقراطية الشعبية
People's Democratic Republic of Algeria

وزارة التعليم العالي
و البحث العلمي
جامعة محمد بوضياف المسيلة
حاضنة الأعمال

Ministry of Higher Education
and Scientific Research
Mohamed Boudiaf University
Business Incubator

الرقم: 0009/ح أ/2025

شهادة توطين مشروع مبتكر ضمن القرار008

تشهد السيد (ة): مدير(ة) حاضنة الأعمال لـ: جامعة محمد بوضياف بالمسيلة

أن المشروع المقترح تحت عنوان:

A digital academy to learn programming, artificial intellegence and IT field

أن الطالب/الطلبة التالية أسماؤهم:

اللقب	الاسم	الطور الدراسي	التخصص	الكلية
عمرون	حسام الدين	M2	الإعلام الآلي	كلية الرياضيات والإعلام الآلي

تحت إشراف الأستاذ/الأساتذة التالية

اللقب	الاسم	الرتبة	التخصص	الكلية
أخروف	سمير	أستاذ التعليم العالي	إعلام آلي	كلية الرياضيات والإعلام الآلي

تم تسجيله على مستوى حاضنة الأعمال لـ: جامعة محمد بوضياف بالمسيلة

خلال السنة الجامعية: 2025/2024

ضمن القرار 008 (شهادة جامعية-شهادة مؤسسة اقتصادية) المعدل والمتمم للقرار الوزاري 1275.

سلمت هذه الشهادة بطلب من المعني (ة) للإدلاء بها في حدود ما يسمح به القانون.

حرر في: المسيلة بتاريخ: 2025/06/09

ع/ مدير الحاضنة:

نائبة مديرة حاضنة الأعمال
بجامعة المسيلة
د/ فضيلة [illegible]

Mohamed Boudiaf University -M'sila- Business Incubator, B.P. Ichbilia -28000 -M'sila
Mail: incubateur@univ-msila.dz Tel .Fax. 035.13.38.49

نموذج العمل التجاري BMC