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Bachelor Thesis

Υλοποίηση ενός serious educational web-based game for java programming tutorial

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Abstract

Teaching and learning are one of the things that humans have been doing for many years and it doesn't have an age limit. People in their lives are taught many things from walking to talking, to even thinking in a particular way for specific matters. The learning experience begins from a young age and it doesn't stop. Peoples first learning steps are taught by their parents and their most important learning curve comes through school.

Through time, learning has taken many forms especially now that technologies are evolved so much, distance learning has become something that people are using in their daily lifes and have grown fond of. The simplicity of logging in a computer and connecting to a platform that provides all the necessary tools that are needed to enhance knowledge, makes it very attractive in so many ways. Nowadays there are too many programming languages, so we can not name them, all but some of the most important and commonly used are languages such as Java, C, Python etc. Usually a programming language is taught in a school or a university or by reading about it in a book or reading the documentation of the language in the internet.

This thesis aims to create a tool that will help students to get more familiar with Java and help them in their laboratory obligations. The application aims, to be used by anybody at anytime and anywhere. This has as result to remove barriers of a conventional classroom and help students learn at their own pace. All the content for this implementation was taken from the official site of Java the ORACLE Java Documentation and the Java Tutorial.

The tutorial has been separated into modules, lessons, courses and sections wherever it was needed. When a user reaches the point to begin the learning of each individual lecture he will be encountered with the theoretical portion and afterwards he might have to answer some multiple-choice questions based on the theory and write some code. There is also an option of completing the course at once for anyone that wishes to challenge his skills

Σύνοψη

Η διδασκαλία και η εκμάθηση είναι ένα από τα πράγματα που οι άνθρωποι αναπτύσσουν εδώ και πολλά χρόνια και δεν έχει όριο ηλικίας. Οι άνθρωποι στην ζωή τους διδάσκονται πολλά πράγματα από το να περπατάνε στο να μιλάμε, ακόμη και να σκέφτονται με συγκεκριμένο τρόπο για συγκεκριμένα θέματα. Η μαθησιακή εμπειρία αρχίζει από νεαρή ηλικία και δεν σταματά, τα πρώτα βήματα μάθησης προέρχονται από τους γονείς και η πιο σημαντική μαθησιακή εμπειρία έρχεται μέσω του σχολείου.

Μέσω το πέρασμα του χρόνου η μάθηση έχει λάβει μια άλλη μορφή ειδικά τώρα που οι τεχνολογίες έχουν εξελιχθεί τόσο πολύ που η εξ αποστάσεως μάθηση έχει γίνει κάτι που οι άνθρωποι χρησιμοποιούν στην καθημερινή τους ζωή και έχουν μεγαλώσει με αυτή. Η απλότητα του να ανοίγεις τον υπολογιστή και να συνδέεσαι σε μια πλατφόρμα που σου παρέχει όλα τα απαραίτητα εργαλεία που χρειάζεσαι για να βελτιώσεις τις γνώσεις σου είναι πολύ ελκυστική για πολλούς λόγους. Σήμερα υπάρχουν πάρα πολλές γλώσσες προγραμματισμού, οπότε και δεν μπορούμε να τις ονομάσουμε όλες, αλλά μερικές από τις πιο σημαντικές και συχνά χρησιμοποιούμενες γλώσσες είναι η Java, η C, η Python κλπ. Συνήθως θα μάθαινες μια γλώσσα προγραμματισμού στο σχολείο ή το πανεπιστήμιο ή από το διάβασμα ενός βιβλίου, ή στο διαδίκτυο διαβάζοντας την βιβλιογραφία της γλώσσας.

Αυτή η πτυχιακή εργασία αποσκοπούσε στη δημιουργία ενός ιστοτόπου που θα βοηθήσει τους μαθητές να εξοικειωθούν περισσότερο με την Java και να τους βοηθήσει στα εργαστηριακά καθήκοντά τους. Η εφαρμογή είναι ένα εργαλείο που μπορεί να χρησιμοποιηθεί από οποιονδήποτε σε δικό του του χρόνο και χώρο. Αυτό έχει ως αποτέλεσμα να αφαιρεθούν τα εμπόδια μιας συμβατικής τάξης ώστε να βοηθηθούν οι μαθητές και να μάθουν μόνοι τους. Το σύνολο του περιεχομένου αυτής της εφαρμογής λήφθηκε από τον επίσημο ιστότοπο της Java, το ORACLE Java Documentation και ειδικότερα το Java Tutorial.

Το Tutorial διαχωρίστηκε σε modules, lessons, courses και sections όπου και αν χρειαζόταν. Όταν φτάσετε στο σημείο για να ξεκινήσετε την εκμάθηση της ατομικής διάλεξής τους, θα συναντήσετε το θεωρητικό μέρος και στη συνέχεια ίσως πρέπει να απαντηθούν κάποιες ερωτήσεις πολλαπλής επιλογής που βασίζονται στη θεωρία και να γραφτεί επίσης κάποιο κομμάτι κώδικα. Υπάρχει επίσης η δυνατότητα να ολοκληρωθεί το μάθημα αμέσως για όποιον θέλει να προκαλέσει τις δεξιότητές του

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1 Introduction

Technology innovation has grown so much in our days that it has become part of our daily life. It has evolved and adapted so much, that most of the devices, or even all, are able to connect to the internet. Computers, smartphones and even smartwatches connect to the internet that has influenced our life by making it simpler in so many ways. We now have access to the internet whenever it is needed, and we can use it in many different ways. A significant element of technology is its ability to alter continually and because of the expanded utilization of technology innovation in the work environment and education it will in future years become progressively significant [1].

Education is one of the most important accomplishment in a human's life, basically without it a human cannot interact with others, can't express himself or communicate. This is the reason why people have paid so match attention to education. People always want to enhance their knowledge in everyday bases to be fitted with the necessary abilities so that they can be able to deal with anything that is on their way. Education has been declared a feasible instrument of change in a positive direction, individuals will be able to make better decisions if they are able to understand certain situations [2].

With the help of technology and the internet, education has gone a step further from the traditional way of learning and has evolved to Distance Learning / Distance Education and e-Learning.

Distance education has a history spanning nearly two decades and this era reflects on important changes in how learning takes place and how it is distributed. The design of various kinds of learning areas may rely on the learning goal, target audience, access, and content type [3]. Distance learning has altered considerably with the use of computer-mediated learning and a range of other techniques. Universities have moved forward to provide distance learning, and many organizations are making significant investments in teaching new techniques[4].

Traditionally for students to get hold of the content of a lesson their physical presence was binding or else they wouldn't be able to get it. With technology rising faster than we thought e-learning became one of the most popular forms of education for all the universities[5]. That for, adjustments were made in the way higher education was conducting the use of e-learning. According to M. Zare [6] e-learning has impacted positively students academical achievements and increased their learning and creativity levels. From one side e-learning provides the students with the opportunity to study in which ever university they want and gave the the chance to the universities to expand their student members.

One thing to take in consideration about supporting distance learning or e-learning platforms is the fact that companies, the industries or higher education systems have to be able to support and maintain them continuously by having the special equipment that is required and the personal to maintain it.

In conclusion distance learning or e-learning with the help of advanced technology and faster internet connection made them very popular among industries, schools, universities etc. and helps to inform and improve user's knowledge of this various platforms. It's a fast-growing trend because of its popularity and effectiveness.

1.1 Synopsis

People use distance learning and e-learning platforms to increase their understanding and better comprehend with something new to them. By taking advantage of those technologies they have access to them every day. One of the most significant benefits is that the concept of space and time is no longer in play, users of these platforms can be literally anywhere on the globe and finish their classes in their own pace and at their own time. Also, the majority of the students nowadays use it for their academic obligations.

This thesis introduces the development and the design of a Distance Learning web-based tool. Its objective is for undergraduate students to complete the course which will help them understand better and learn the Java programming language. The content which is used for the course is taken from Oracle Java Documentation and more specific from the Java Tutorial, so the content is quite precise, and everything is up to date with the official Java language. The most commonly way to create such a tool is by creating a website. The websites front-end has been developed with Vue.js that is a web-framework for developing websites, specifically for the front-end it uses Vuetify that is a framework that creates the interface components. Node.js is being used to install any kind of packages that are needed, for the authentication of a user, Firebase and MySQL are used to store any other kind of information that the site needs. For the communication between the front-end and the Back-end Axios.js and Express.js are used for connecting to the database and making SQL queries and retrieving the data and then Axios can read this data and use it in the front-end and display it.

1.2 Motivation

The motivation for pursuing this thesis was to design a website that would help students or anyone that would care to learn the Java programming language. For the students this meant that they didn't have to attend a class physical but instead in their own time they could use it by just login in and completing the course. Also, the designing and developing process of building a website using fairly new technologies and trying them was quite intriguing and had many ups and downs. Finally, being a part of research laboratory team in the university was very compelling and it came with many benefits.

1.3 Objectives

The primary goal of this thesis was to create a tool which would provide the students with the possibility to learn from their homes, workplaces etc. and give to the students the opportunity to complete the course in their own time. Furthermore, one of the main objectives was to use the official manual of the language that we selected for the course that is being taught. Following the course "Principles of Software Engineering" by the Hellenic Mediterranean University the programming language that is used at that time in the laboratory is Java. So this platform or otherwise this website was made to follow this course. The course is divided in two main parts and a third one that's optional.

Part One: Theory

The first part contains the theoretic part of the Course.

Part Two: Lab Exercise

The second part contains the exercise portion of a lesson which has a possible quiz from that lecture and program part.

Part Three: Challenge Mode

This part is a Challenge either in the whole course or a single module (we will discuss about modules further down).

1.4 Outline

Chapter 1 "Introduction": The Introduction chapter covers a short introduction including the Synopsis, Motivation, Objectives and the Outline of the of the chapters for this thesis.

Chapter 2 "Background": The Background chapter gives information about e-learning and distance learning, what are they, where are the used and what effect do they have on us. It describes Frameworks and Methodologies and at last Platforms and Tools that support distance or e-learning.

Chapter 3 "CORE: Learn java Online": The CORE: Learn java Online chapter covers A System Textual Description the systems analysis and system design and at last the Technologies used to develop CORE

Chapter 4 "Pilot Implementation": The Background Pilot Implementation covers the Pilot Implementation Mythology, the Implementation of "User's Sign Up and User's Sign In", Implementation of "User's Progress" and the Pilot Use case which are User completes the course with its normal flow and User completes the course at once

Chapter 5 "Conclusion & future work": This final chapter presents the results of this thesis in a Conclusion and the Future work of the CORE: Learn java Online.

2 Background

The second chapter of this thesis presents and analyses the background which contains e-learning and Distance Learning definitions, usage, theories, ideas and effectiveness about each subject. Furthermore, it consists of Frameworks and Methodologies for e-learning and distance education. Finally, references are made about Platforms and Tools for supporting distance or e-Learning.

2.1 Distance Learning / Education & E-Learning

In the era of technological growth, fast internet and with the assistance of computer scientists, the academic field has been greatly created into something more than the traditional manner of education. With the help of those new technologies teaching and gaining new knowledge has found a different form that isn't limited through time and space [7][8].

Those new forms of education are called as we know them today, e-Learning or Distance Learning or Distance Education. Distance learning, distance education and e-learning occur because the technology helped them get in this state that they are today. These new technologies made it possible to learn from the internet and gave really good options to when and where the teaching and learning would happen and made it possible that a lot of learners could benefit from it[9][10]. Because distance learning became one of the fastest web-based technologies, it had as result that many universities, industries and big companies adopted this form of education.

Electronic learning or also known as E-learning ,Welsh [11] describes it as the utilization of PC arrange innovation, essentially over an intranet or through the Internet, to convey data and guidance to people. So, e-learning is basically any type of training that is assisted by the Internet and its advances and incorporates the utilization of the World Wide Web to help guidance and to convey course content. It also can be defined as the art of learning without books and any physical educational materials, but with the help of technology,

E-learning is becoming one of the fastest emerging delivery systems of information and education in the era of modern education [7].The popularity of e-learning comes from the fact that the lessons are not strictly based on text forms but it's a combination of text, video ,audio etc. All the e-learning platforms are web-based and mostly computer related but other forms such as mobile based are coming to surface.

Distance learning or distance education as M. Craig l[12] describes, is a field of education that aims on the instructional method, innovation, and instructional framework plan, that are viably consolidated in conveying education, to educate the student and allow him to contact with the teacher asynchronously and synchronously. Y. Waykar [13] describes distance education like an established learning movement where students and teachers are isolated by topography, time or both for most of the instructional period. Distance learning materials are conveyed through an assortment of media like, print, audio, video, PC software and other online innovation. Educators assist distance students through correspondence by means of mail, phone, email, or online advances and software.

E-learning, distance learning or distance education are divided in two major categories: "Synchronous learning" and "Asynchronous learning". Synchronous learning requires both

teacher and the learner to be online at the same time and communicating through either an online chat or a video chat the time that the lesson is taking place. That resembles the traditional way of education, although both the students and teacher are in different places in the same time. On the other hand, asynchronous learning doesn't require the teacher and the learner to be online at the same time which means that the lesson is pre-recorded and accessible to the learner at any time with only one possible limit having a deadline for completing the lesson. As said those two types of learnings are the most frequent but there is also a "blended learning" or else called "hybrid distance learning" Blended or hybrid learning has various forms that are composed from both synchronous and asynchronous learning and is mostly used in class learning institutes that don't have enough space [10][11][14].

People started to use e-learning and distance learning platforms due to the fact that the only requirement need it is having a personal computer. In the era we live, most people have at least one computer or a smart device. This is an optimal situation for individuals who work and have no time during the day, making it easy watching the classes at their own free time at the later hours. With that being said also they can watch the lessons that they want, wherever they want and lessen their cost of traveling. The idea of E-learning is starting to dominate nowadays as a result, a big number of universities offer a degree through E-learning platforms. Likewise, a lot of the big companies start to devote their attention in e-learning because they are able to mass educate their employees.

After the specialists examined, the exploration touched base at the general end that e-learning is a piece of the new power that portrays educational frameworks toward the beginning of the 21st century. Thus, the idea of e-learning can be relied upon to keep advancing for quite a while. At this day and age, learning needs change all around rapidly and the idea and elements of e-learning must ceaselessly be adjusted to these necessities[8].

Advantages and disadvantages of E-Learning / Distance learning

E- learning and distance learning have many advantages which are definitely the reason why they are such a popular form of education nowadays and why so many higher educational systems prefer it

Starting the first benefit of e-learning is that the learner-user gets to decide when he is going to attend the lesson he wants. [14][15].

Another advantage is that because the lessons happens through the internet there is no constraints one where the learner has to be geographically[10] [12][14].

So, because there are no limits on the where and when, the person can have his one pace of learning which is great because then the age factor and the state of the learner doesn't affect him[10][14].

Again, because the learner has as much time as he needs, he has the whole internet available to himself if he needs to be assisted with anything that's related to the lesson[12][14].

With e-learning universities but especially companies are able to educate more learners at once because in a e-learning class space does not exist and an instructor is not needed and makes it easier to train more people in less time. As a result, these companies save money and time and improve their performance[11].

Another advantage is that Staff members or instructors work less desk hours than they used to because there are no physical classes to attend to. Also considering that the software for the distance learning program exist, the staff members can change its content relatively easy and set it up as they think is best for the learners[11] [12].

One more advantage is that the instructors-staff members can easily keep track of the progress that the learners are making through the e-learning platform and the learners can keep track of their scores [10] [11] [16].

Now despite of all the advantages and benefits that the e-learning platforms have to offer, there are enough disadvantages to keep in mind before one is considering them.

The first and the most important disadvantage of e-learning is that not all the learners-students are able to acquire the equipment needed to view the lessons and also not all of them have the skillset to use a computer and the internet[11] [12][15][16].

Although that English is the world official language people may experience language obstructions and, in this process, lose translation[12].

If a lesson type is synchronous learners may face the problem of time-zone if they live across the world in relation with the organization that supports, it[12].

One more problem that could occur is, that if there is no video-type proof the staff members don't really know who completed the course so, they can never be sure that the actual learner took the course[14][15].

Another big disadvantage in relation with the conventional type of education is that mostly in asynchronous learning the feedback of the teacher-instructor doesn't always come immediately so the learner must wait an unknown period of time[10].

Distance learning does not offer the students the chance to exercise their oral communication skills, so they don't get a chance to interact with other students nor their professor. Furthermore, because the students are apart from other students they miss physical interaction[10][16].

Also, the staff must be trained and intimate with computers on the e-learning/distance learning platform[12].

2.2 Frameworks and Methodologies

Frameworks

There are many e-learning Frameworks that have been developed nowadays with different number of dimensions.

The first one that is going to be described is one of the most popular. Badrul Khan's **eight-dimensional e-learning framework** [17] as also seen in the Figure 1. Badrul Khan's eight-dimensional e-learning structure is a point by point self-appraisal instrument for establishments to arrange their assessment of instructive innovation (e-learning) status and opens doors for development. The framework gives a structure to methodically look into activities and projects, with the goal of ideal learning results being accomplished. The framework is made out of eight dimensions, Khan's structure was created as a reaction to inquiries from pursuers mentioning to see models of viable Web-based guidance as characterized in Web-Based Instruction. The framework does not comprise a model since it doesn't recommend a particular procedure for

creating instructive innovation situations. In any case, it takes into thought the design, development, delivery and evaluation of web-based and hybrid instruction[17].

Figure 1 Bardul khans eight-dimensional e-learning Framework[17]

The eight dimensions are :
- **Pedagogical:** E-learning's pedagogical dimension relates to learning and teaching. This dimension discusses problems related to content analysis, audience analysis, goal assessment, medium analysis, approach to design, organization and strategies for teaching.
- **Technological:** The e-learning technology dimension examines technology infrastructure problems in e-learning settings. This involves planning of infrastructure, software and hardware.
- **Interface:** The interface design relates to e-learning programs ' general look and feel. The dimensions of the interface design include page and site design, content design, navigation, availability and usability testing.
- **Evaluation:** The e-learning evaluation involves both learner evaluation and the learning environment evaluation.
- **Management:** E-learning leadership relates to the preservation of the learning setting and data distribution.
- **Resource support:** The e-learning resource support dimension examines the internet assistance and resources needed to promote meaningful learning.
- **Ethical**: Ethical e-learning factors relate to social and political impact, cultural diversity, bias, geographical diversity, diversity of learners, digital divide, etiquette, and legal problems.
- **Institutional**: The institutional dimension deals with problems linked to e-learning in administrative relations, scholarly affairs and student facilities.

Another Framework is the **LearnCube: Conceptual framework for E-learning** in Secondary school. S.-K. Haw [18] describes it as multi-dimensional conceptual framework for e-learning. LearnCube could be used as a government and school reference framework aimed at implementing e-learning. LearnCube contains 6 main dimensions with 18 numbers of variables within the dimensions. The dimensions are Student, Teacher, Technology, Course Content, Design, and Support. In Figure 2 we can see the framework visually
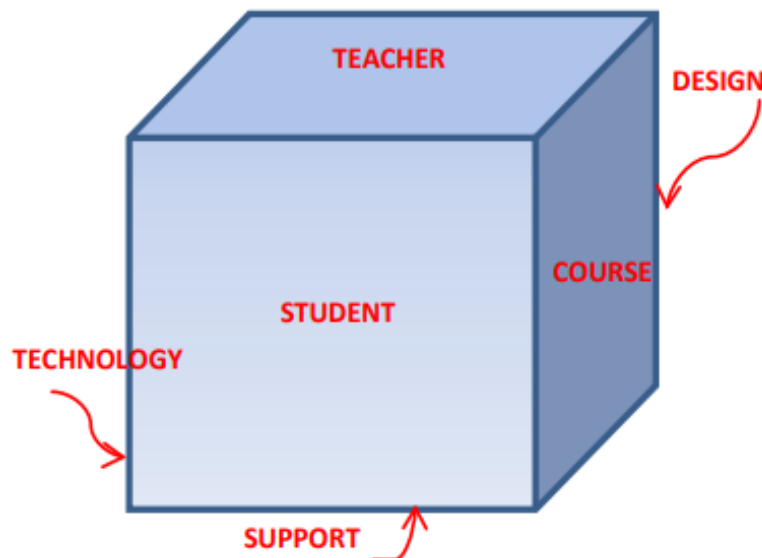
Figure 2 LearnCube: Conceptual framework for E-learning[18]

- Student: Characteristics of students generally connected with e-learning attitudes and motivations
- Teacher: The Teacher is one of the most significant factors affecting e-learning achievement because learners think that teachers need to approach e-learning in a friendly and vigorous way to generate a favorable e-learning atmosphere
- Technology: Technology is the e-learning key enabler
- Course Content: Flexibility is the primary problem in the aspect of the Course.
- Design: The design dimension contains precision, smooth flow, accessibility, navigation, authenticity, and output design and suitability.
- Support: Since educators are the most important resource for providing quality education to each student, leadership level must guarantee that the college is fitted with pleasant settings that educators feel comfortable and yet have the chance to grow and learn as experts.

Another Framework is the **Theoretical framework** that includes the three primary parts of the information systems, these are people, technologies, and services. People communicate with schemes of e-learning, E-learning technologies allow the various user groups to interact directly or indirectly. Technologies promote content integration, communication and collaborative tools. E-learning services incorporate all operations that match pedagogical models and teaching strategies. The complicated interaction of e-learning systems is the direct or indirect action. Simultaneously, systems provide services based on the activity policies indicated. Service requirements, in other words, are e-learning activities aligned with pedagogical e-learning models and educational strategies[19].

In the Figure 3 we can see a visual representation of the theoretical framework.
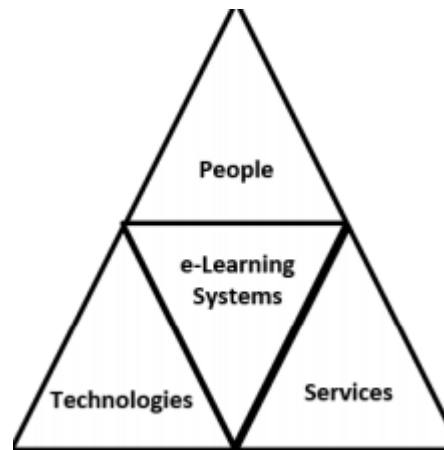
Figure 3 Theoretical Framework[19]

Methodologies

As A. Dhabi [20] describes, every methodologies has a particular attitude to customizing its e-Learning system policies and processes. The development of a methodology is a step-by-step process, it is necessary to know the content, the scope and the sophistication of the presentation and how the evolution will be incorporated into the material. To compare each methodologies to each other there are used six criteria's: Usability, Incapacitated Users, Global Audience, Standard Use, Content and Functions Reuse, System Design. Furthermore A. Dhabi [20] compared some of the most popular methodologies, the most recognized are the:

ADDIE MODEL: ADDIE model is an iterative instructional design method, meaning: **A**nalysis, **D**esign, **D**evelopment, **I**mplementation, and **E**valuation.

Data Inc's: Data Inc's is a roadmap for e-learning that uses a gradually strategy to developing content. It was tailored to develop and deploy different e-learning modules, including dashboards and campus gateways, as well as learning management systems.

Edu-Interpretation: Edu-Interpretation contains a seven-step learning development that gives you the chance to handle online or hybrid training in a practical manner based on the goal: knowledge transfer that the student can apply in his professional life.

Methodology to develop e-Learning systems: The concept of this methodology is to develop an e-learning scheme that favors the organization's competitive position that utilizes it and adapts to the requirements of the student / employee.

Methodology and tools for the generalization of e-Learning in the continuous formation: The concept of this methodology is to build and develop an e-learning scheme where people who are not highly qualified can be ready to communicate with it in e-learning training procedures.

IADIS e-Learning: This methodology for developing e-learning systems is suggested through

the knowledge acquired in developing multimedia content apps and their use in exposing the model and design procedures of evaluation.

ENN-INS e-Learning-Methodology: The concept of this methodology is to portray the e-learning content that consists of different courses (lessons) where learning content becomes learning objects effectively and pedagogically.

2.3 Platforms and Tools for supporting distance or e-Learning

E-learning platforms are the traditional classroom's present-day digital replacements. Platforms are the location to host your e-learning course, allowing you to share and upload files, videos, chat with members, grade their job, etc. An e-learning platform is a collection of interactive internet facilities that provide data, instruments and resources for instructors, students and others engaged in education to promote and improve the delivery and management of education. There are many e-learning, distance learning tools all across the internet that vary from one to another. Those tools nowadays are not only supported by computers but also from tablets, phone, etc. generally from all the smart devices.

There are Learning Management Systems (LMS) and Content Management System (CMS). An LMS is an internet platform enabling materials, resources, instruments and events to be delivered to learners in and out of the school setting. It enables educators to give tailor-made training that learners can access at any time without any geographical limitations [21]. CMS assists teachers in cataloging, tracking and managing business data. A CMS is efficient when there is a need to track and manage significant quantities of data and is optimal for big companies [22].

Open e-Class

The Open e-Class platform is an asynchronous e-Learning service that offers a full course management solution provided by the Greek Academic Network GUnet. It was intended to promote the standard educational process. GUnet actively supports it and is distributed as open-source software free of charge. Anyone can connect to the e-Class platform easily through a web-browser without any technical knowledge. This platform was intended to support a different method of teaching and learning. Teachers can construct on-line classes rapidly, using current instructional materials such as texts, records, lectures, images, video, exercises, etc. Students themselves can use an alternative channel to access supplied products [23]. E-class has many features like Compatibility with all browsers, Adaptive User Interface, Compatibility with e-learning standards.

Moodle

Modular Object-Oriented Dynamic Learning Environment or else known as Moodle is a Course Management System (CMS) and is another e-learning platform which its software is

supplied as an open source[24]. Moodle was created by Martin Dougiamas its programmed in php with a SQL database, so any computer will be able to run it without needing to install anything.

Moodle is a template-based scheme that needs to be added to content. This makes the interface of Moodle very user friendly and makes it simple to navigate. The entire page is provided in a format of "flat point of view." It is arranged in tiny blocks and structured according to a subject or weekly outline around segments. Each section has its own instruments, including classes, quizzes, tasks, and forums. All blocks on a page can be organized separately and the components can be readily relocated or concealed within each section[25].

Google-Classroom

Google Classroom is another Google's creation of educational organizations to guarantee a mixed learning platform, to simplify paperless creation, distribution and classification of tasks. With Google Classroom, educators and learners can sign up for class tasks, course materials and get feedback from any computer or mobile phone. It incorporates digital media online with traditional techniques in the classroom. It is therefore a useful way for educators to participate learners online to ask questions, discuss any subject matter with professors and colleagues, and submit tasks[26]. Google Classroom most important features are that saves teachers time, easy support for administrators, communicate and collaborate.

eFront

E-Front is an e-learning tool that is primarily a Learning Management System or LMS. eFront is an open source software and developed to help create online learning groups while offering different possibilities for collaboration and interaction via an icon-based user interface[27]. The platform provides instruments for creating content, constructing tests, managing tasks, reporting, inner messaging, forum, chat, surveys, calendar and others. eFront is frequently included in the lists of familiar open-source teaching schemes or as another option to Moodle. Multiple scientific papers and technological sites portray the system from the perspective of functionality, usability and norms.

Udemy

Udemy is a very popular e-learning platform amongst others that is intended for professional adults. Udemy utilizes its material from internet content-creators to make profit, unlike academic Massive Open Online Course (MOOC) programs powered by conventional college coursework. The Udemy courses at this time are not credentialed from any university so students take those online courses to help improve their skill for a job or a university class. Some classes provide credit for technical qualification, Udemy attempted to lure corporate instructors wishing to generate training for their company's employees.

TalentLMS

TalentLMS is mainly used as a staff training instrument for tiny to medium-sized businesses that emphasizes functionality and workflow but can also handle bigger facilities with thousands of registered customers. The platform provides instruments for creating and re-using content, constructing tests, managing assignments, reporting, inner messaging & conversations, surveys, and others. It can also be used to sell internet classes. TalentLMS has the required built-in instruments to assist everyone engaged from yourself, your learners and the IT staff, making it easy and convenient for all customers to visit the portal.

Administrate

Administrator is software delivered from the cloud, for training and learning management. The software enables, train businesses and training departments handle their entire company. The embedded online system is designed to make your training management simpler, to help you deliver excellent eLearning and helps you keep your website up-to-date. Some of it's features are: Custom Course Templates, Marketing Campaign Manager, Automated Communication and Powerful Reporting Engine.

3   System Analysis & Design. CORE: Learn java Online

As we mentioned in previous chapters the goal for this thesis was to create a distance learning app (CORE) that would help anyone to learn Java online from anywhere and anytime they want. So, the third chapter of the thesis begins with a System Textual Description of the application and later on System Analysis and System Design will be presented which including de System requirements, requirement diagrams, component diagrams, Entity Relationship Diagram (ERD) and Activity diagrams. Lastly the technologies used to develop the CORE application are being described.

CORE System Textual Description

The design of the application was very challenging as it was my first real web application, so some mistakes were done before and during the developing of the app. Because some considerably new technologies were used at the beginning there was no indication that they would be a problem for designing the app. One of them was firebase. Starting to create the app, it was discovered that it had some limitations on how many simultaneous connections it could manage using the free version. Despite its simplicity and how easy it was to use ultimately the shift to a MySQL database was made, except from the authentication portion of it. Because time was limited for the completion of this project the use of firebases authentication was kept. This happened because Firebase's authentication was easy to use and also the limitation of the authentication was so big that it didn't really matter for the time being (as I will describe in the future work chapter it's something that eventually will also change). As the database structure was set up now the app is working fine but because by switching from Json logic to SQL logic, efforts were made to keep the json logic as much as possible, so there wouldn't be a lot of code changes. This will affect future work which is also going to be describe in a later chapter. Setting aside those two factors the app is running for its current form.

The app begins with the user either log-in in or registering. In the first case as described above the authentication happens with the help of firebase, in the second case the user fills out a register form and after the user hits the register button two things happen. First the user's username, email and password that's encrypted is sent to the firebase authentication tool and second every other information about the user except the password is stored in a table in the MySQL database. Now that the user is logged in, the app gives the user the choice to either complete the whole course at once by answering some multiple-choice questions and writing a program,[if the user thinks he already knows the language and he just wants to test his skill] or he can procced to the actual course following the normal flow. Now, at any point time given, the player can choose to complete the course at once even if he has completed half of the course. If the user doesn't select to complete the course at once he proceeds to complete the course by following a timeline that is predetermined. The timeline is divided to modules which composes the course, every module can have lessons, chapters and sections, these are also following a timeline. Once more the user is encountered with two options completing the course by only taking a specific module which also consists of multiple-choice questions and writing a program. The option of completing the entire module at once is given if the user thinks that he already knows a particular module and

he doesn't want to follow its timeline.

Finally, if someone decides to take the course from the start, he will be navigated through the modules in the order of the timeline. As it was described not all the modules have lessons, not all the lessons have chapters and not all the chapters have sections. When the user reaches the stage to begin, the user will first encounter the lecture part which consists of the theoretical part that is presented in a pdf like format. The content as described in previous chapters is taken from the Oracle Java Tutorial so it's exactly the same and that's the reasoning behind the pdf format. Afterwards the lab exercise part will take place and it is divided in two parts. The first part is questions with multiple-choice answers and the second is the code part where he has to write a program, both parts are relevant to the lecture part. These parts don't necessarily have to exist what means that a lecture can either have only the questions or only the program part or it can have both or none of them.

3.1 CORE System Analysis

The intention of creating this project was to build a tool that would help my supervising professor in his laboratory class (Principles of Software Engineering). The first thoughts were to take the laboratory content from e-class which is used to teach the students and present it in a series of a 14-week lesson course that a student would have to complete in order to pass the laboratory part of the class. The second thought was, why should we be restricted to the content of the laboratory class and not create a more universal application which could be applied to not only the students of the university but everyone that wishes to learn java. Therefore, the most efficient alternative for creating this application was by using the official Java language provider. By looking up Oracle Java Documentation and furthermore the Java Tutorial we took the content of "Trails Covering the Basics". So, by doing this we now are sure that our content is the official of the language we use for the application.

Now that we have covered the part of the content, we also have to analyze what the application is going to do and why. As we said, previous the target with this application was to help with laboratory class, but this target shifted a bit and it got more general so now the app doesn't target only the students of this specific class it also references any java class from any university and anyone that wishes to learn the java programming language. Eventually the application can either start your Java programming learning process from the beginning or if someone is more experienced, they can challenge their abilities by finishing it at once or through a sequence of modules.

Requirements List

As seen in Table 1 the Requirement list is presented. In this table the most important Requirements are presented by their titles and their description.

Requirement	Title	Description
REQ1	User Authentication	For the user to be authenticated he has to be in the Firebase
REQ2	Front-end	The Front-end essentially is the graphical interface

		that the user corresponds with and completes his course
REQ3	Player option	The user gets the chance to pick the way he wants to complete the course either being at once or in the normal way.
REQ4	Stages	The stages of the current version of the app are the Modules, Lessons, Chapters, Sections that the user can be in
REQ5	Back-end	The Back-end provides all services for making the app operational and connecting the MySQL database with the app through our custom Rest API
REQ6	Repository	Repository is composed from the Firebase and the MySQL that are used for the application the first through Firebases own services and for MySQL we builded our own API
REQ7	Hardware	Being a web-based application the only hardware requirement for a user is to own a computer
REQ8	Appropriate content	The content was taken from the official java web site from Oracle Java Tutorials
REQ9	Dynamic content	When the user selects any module, lesson, chapter, section the content has to dynamically change
REQ10	Lecture	The user has to take also his theoretical part before starting the exercise
REQ11	Quiz Dialog	The user takes a multiple-choice question and answer
REQ12	Compiler	The user writes his own program either with the embedded compiler in the application either with the external link or he can use his own.

Table 1 Requirement List

The "CORE" requirements diagram for the application which also is the main requirement diagram is shown like a package in the Figure 4. The main requirement diagram is composed from:

- Application
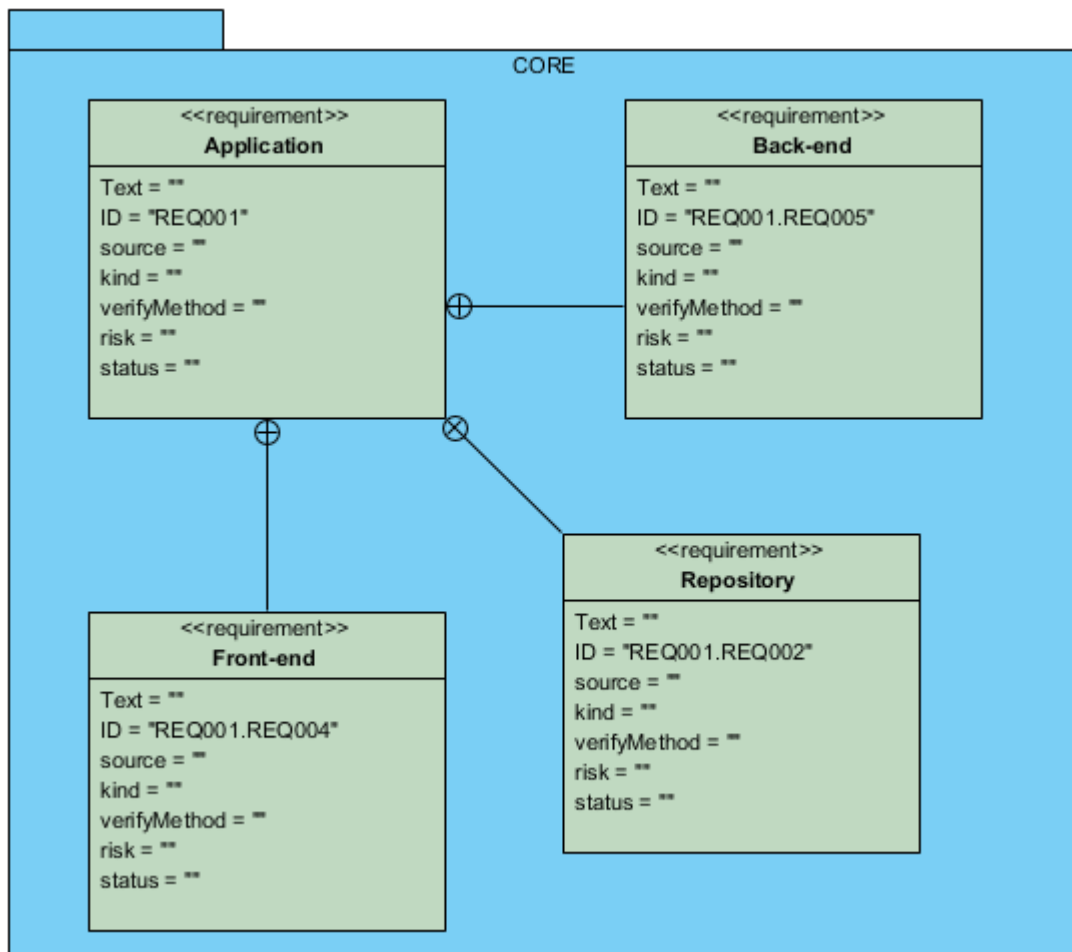- Front-end
- Back-end
- Repository

Figure 4: High Level Requirements Diagram

As shown in the Figure 4 the main requirement diagram CORE contains the 'Application', 'Front-end', 'Back-end' and 'Repository' The 'Application' requirement is the most significant part that describes how everything works and is surrounded by all the others. The 'Front-end' describes how the components react, the 'Back-end' talks about the services it needs to run and at last the 'Repository' contains the different databases used. Each component has sub-requirement diagrams that will be analyzed further down.

Application module Requirements Diagram

As shown in the Figure 5 it features the Application which is the most significant part and the one that every other requirement is connected to. The application describes essentially how the app works, the main are 'Create log-in and register form', 'Create Stages' and 'Give player option to complete at once'. The 'Create Stages' connects with 'Create Stages functions' that basically give the app all the functionality and also to 'Must have a flow', that provides a flow between them. Furthermore, the 'Must have a flow' consists of 'create Module', 'create Lesson', 'create Chapter', 'create Section', 'create Lecture' and 'create Exercise'. At last the 'Create Module' connects also with 'Give player the option to complete it by modules'.
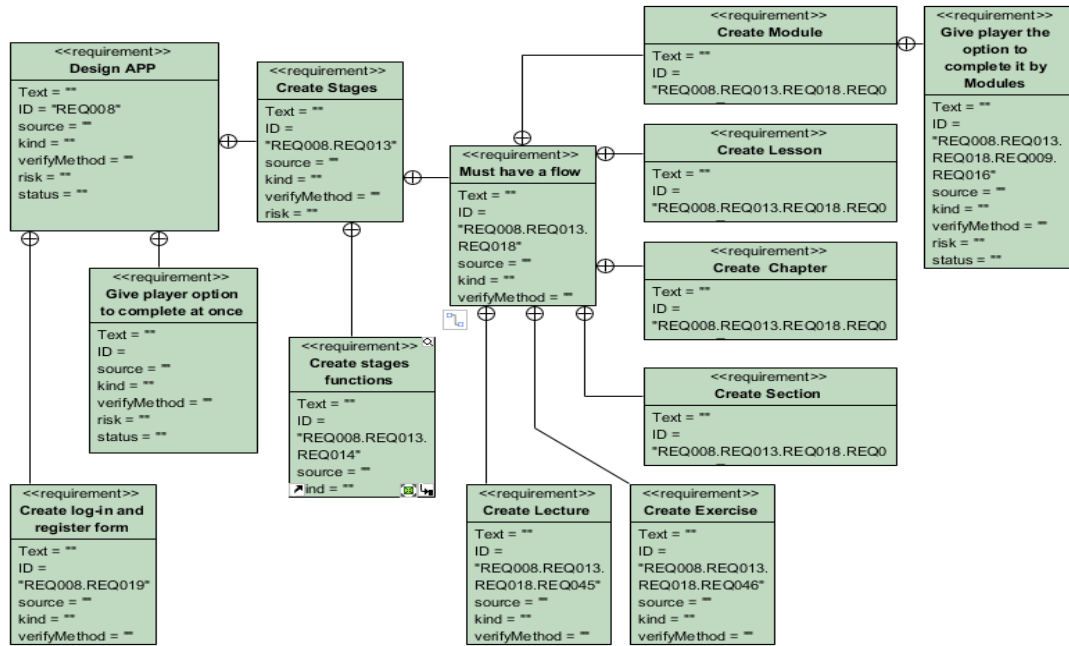
Figure 5 Application module Requirements Diagram

Front-end module Requirements Diagram

Front-end as seen in the Figure 6 main requirement is the 'Create UI Components' that is composed from the 'Customize User's UI depending his status' which will customize the user's progress depending his status, the 'Create top toolbar' that contains the navigation bar, the 'Create timeline' which can be seen in the page of Lessons, Chapters, Sections, the 'Make it responsive' that helps with the responsiveness of the application depending the users screen size and finally the 'Style the UI components' which makes all the elements appear more appealing to the user. Now the 'Create toolbar' has the' Create list tiles' and 'Create timeline' has 'Create cards' which has 'Create buttons' that are used for the timeline.
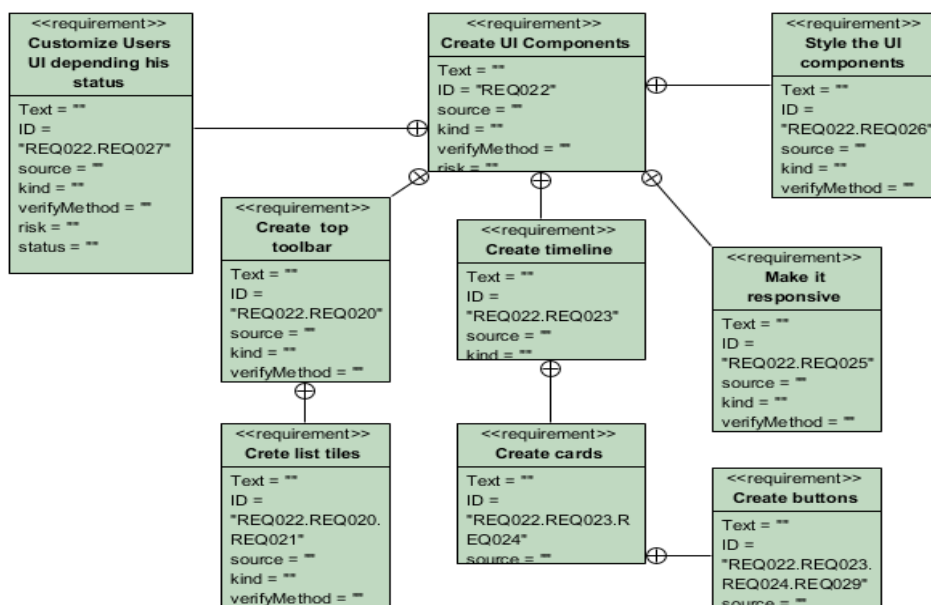
Figure 6 Front-end module Requirements Diagram

Back-end module Requirements Diagram

'Back-end' as seen in Figure 7 begins with 'Authenticating user' that happens through the Firebase and after that 'Take user's' status which for every user there is an entry in the SQL database with his status. After those two, the requirement of 'Execute services depending the state of the application' takes place where depending in which point of the application you are the corresponding services run and its connected with 'Get content depending the stage', 'Get Lecture / Exercise information' so basically this gets the multiple-choice questions and the write code part and at last 'Update the user's status'.
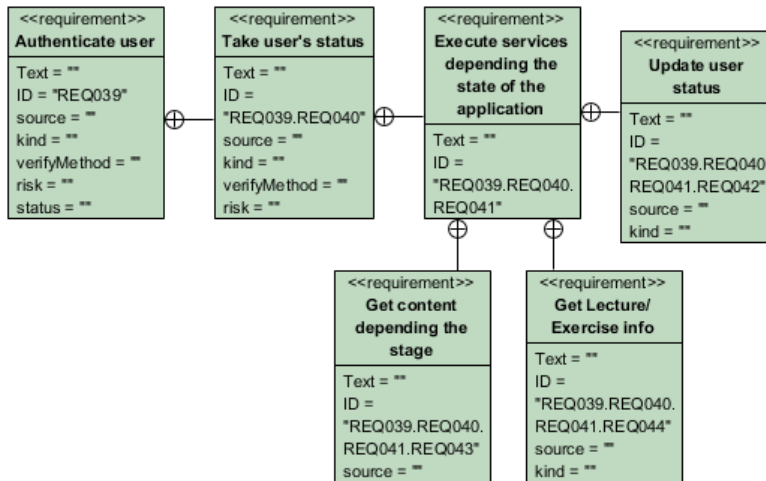
Figure 7 Back-end module Requirement Diagram

Repository module Requirements Diagram

Finally, the 'Repository' as seen in the Figure 8 connects with the 'Database with application' and 'Connect with Firebase'. The 'Connect with Firebase' furthermore connects with 'User Authentication' that needs to be done so the user can be authenticated to the application during his signing in. The 'Connect the database with application' that is done through the Rest API that we created, connects with 'Create database' that connects with 'Create tables' that with insert content from Oracle Java and finally the 'Define table state', so basically the database handles everything except the authentication part
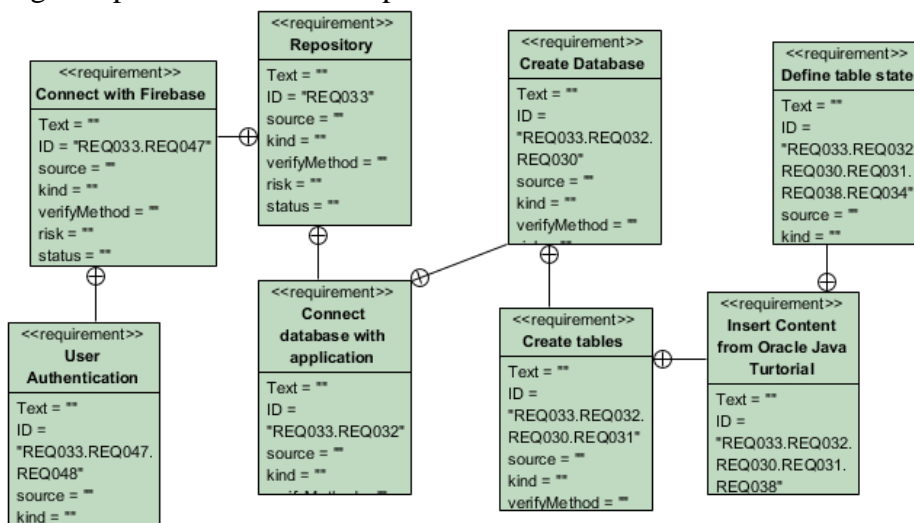

Figure 8 Repository module Requirements Diagram

3.2 CORE System Design

In the System Design we are going to display through a various of Unified Modeling Language (UML) diagrams to showcase how the application was designed. UML is a standard language in the field of software engineering and its widely used for visualizing and building software-intensive systems [28].

The UML diagrams that will be displayed are

- Use case Diagram
- Component Diagram
- Activity Diagram
- Entity Relationship Diagram (ERD)

Use case Diagram

For a new software application which is going to be developed, the use case diagram helps visualizing a system's functional requirements, the connection between "actors" and vital procedures and the interactions between distinct instances of use. As you can see in the Figure 9 the use case diagram is illustrated with the user login which is authenticated by the repository. Then he is confronted with the option, to how to complete the course. At all times the user can logout from the application and close it and come back whenever he wants.
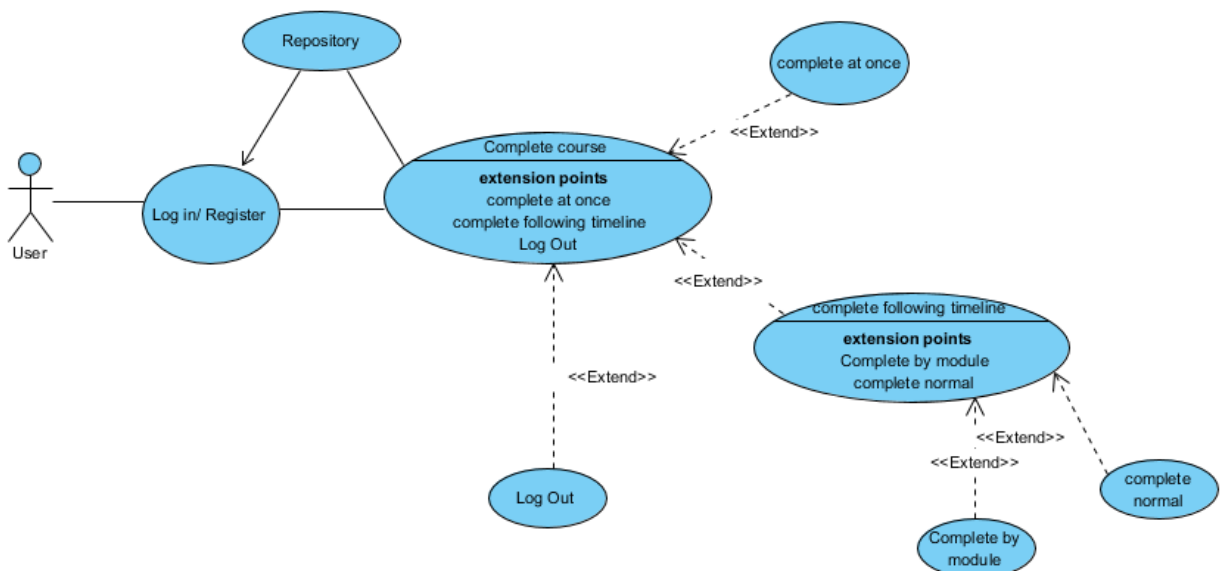

Figure 9 Use Case Diagram

Component Diagram

Component diagrams are utilized in displaying the physical parts of a system their goal is to demonstrate their connection between various components in a system. The Figure 10 is displaying the component diagram of the application and it shows how all the components are

connected to each other to form the final application. The application runs in a web browser as it is a web-based app, additionally it's connected with the databases, Firebase and MySQL which the Firebase authenticates the user and MySQL through the Rest API connects with the application. And finally, the application uses Node, Express.js, Axios.js, Vuetify to make the app functional and operational.
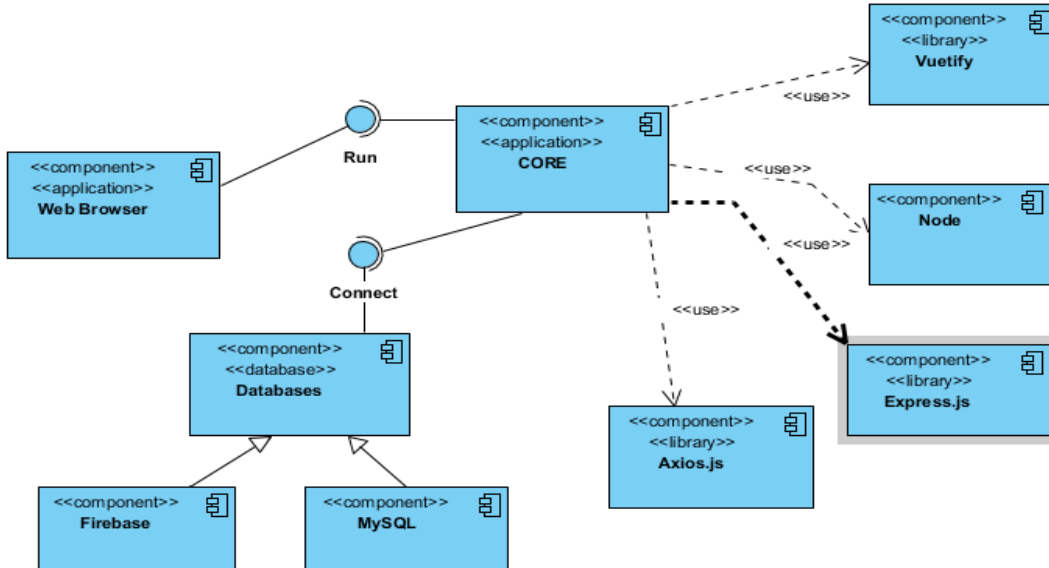

Figure 10 Component Diagram

Activity Diagram

An Activity diagram is fundamentally a flowchart to serve as the flow form from one activity to another, that is characterized as a task of the system. The Figure 11 represents the flow of events for the complete run of the application. The activity diagram essentially shows how all the activities and actions are connected to each other and how the decision nodes can affect the path that the user is going to follow. Once again, the first thing that the user has to do to procced to the course is to login, if he has no account he has to register. After that he decides if he wants to complete course at once, if not he proceeds with the normal flow of the timeline.
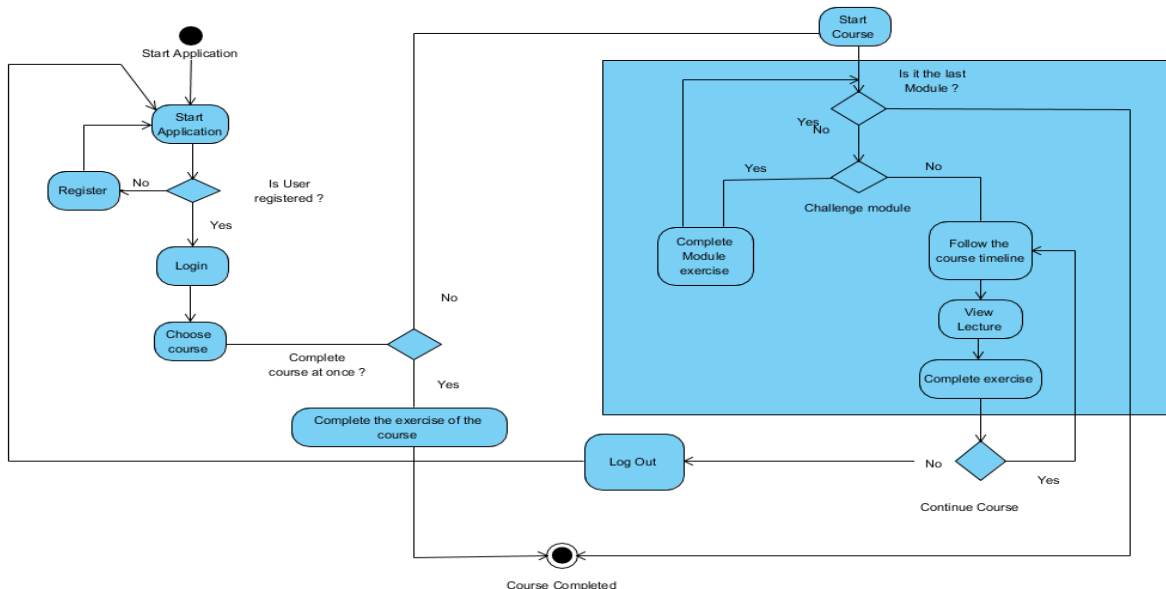

Figure 11 Activity Diagram

Data Repository Schemas

SQL data repository ERD

ERD or Entity Relationship Diagram demonstrates an entity of objects, sets that are stored in a database within a system. Basically, the ERD helps to design the Database of an application. The connection and communication between the MySQL database and the application happens with the help of the Rest API. For the part of the application that uses SQL database as its storage there have been designed three different ERD models to represent all the possible outcomes of the application.
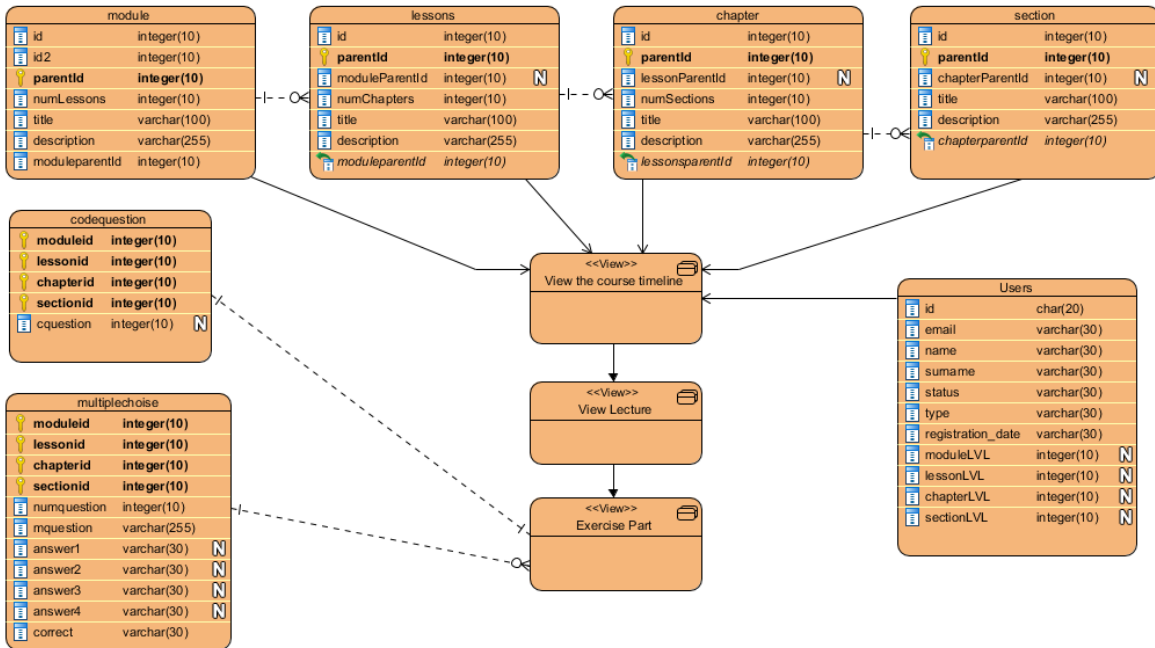
Figure 12 ERD normal flow of application

The Figure 12 showcases the normal flow of the application that the user has selected to follow by completing all the modules, lessons, chapters, sections wherever they exist. Unlike the Figure 13 and the Figure 14 that showcase the user selecting to complete a entire module or complete the course at once.
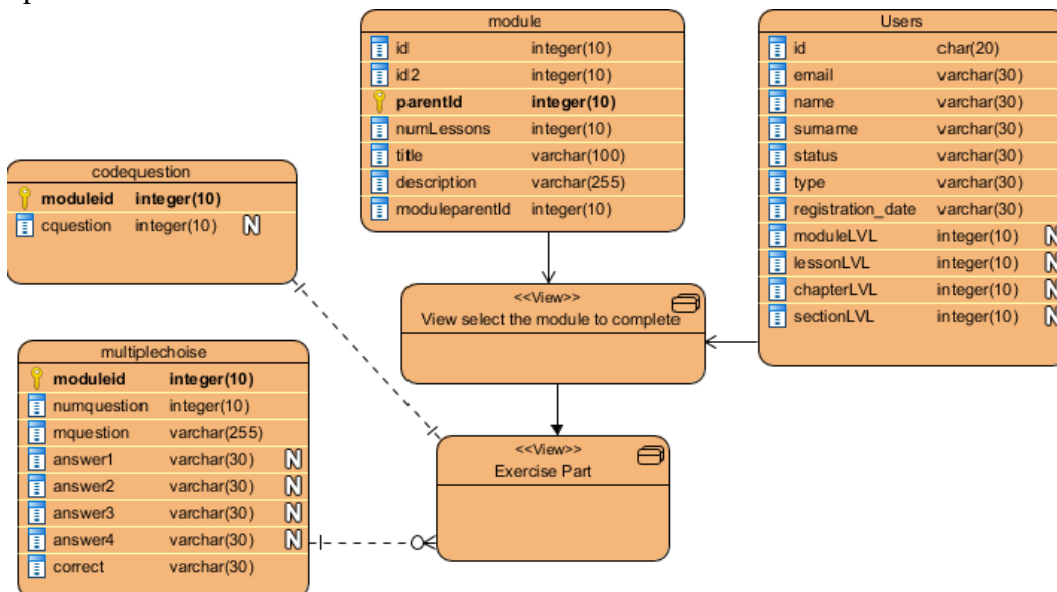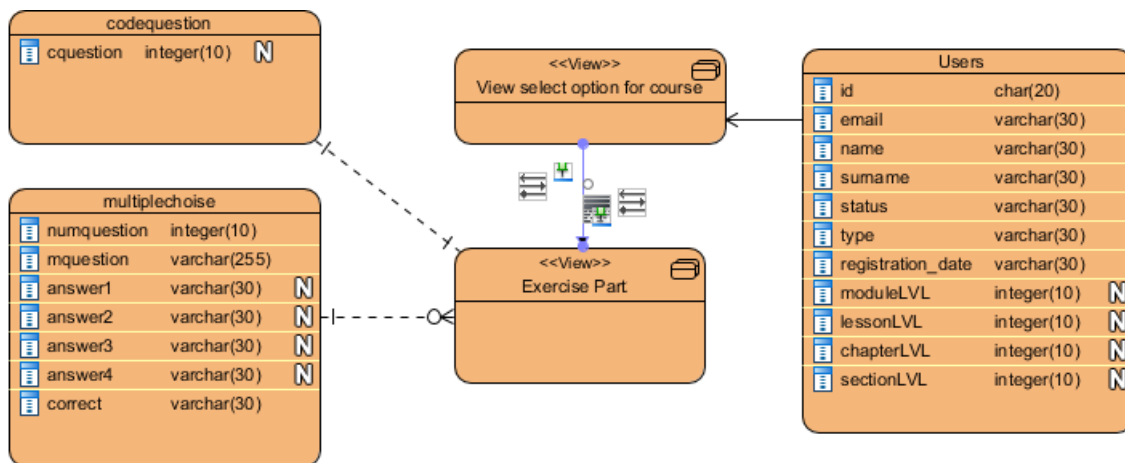
Figure 13 ERD complete by module

Figure 14 ERD complete course at once

To summarize the UML diagrams that were presented in this subchapter may help you get a better understanding how the application works its design and how the different components react with each other. UML diagrams vary so it is good to use as many as possible for the design.

NO-SQL data repository

As we said, the only part that's left from the Firebase is the authentication part, that means when the users signs in or registers, two actions happen. First the user is authenticated through the Firebase and after it gets the rest of the information for the user from the SQL base. So, for the authentication of the user, firebases services were used so there is no actual ERD diagram to design and display.

3.3 Technologies Used for CORE.

This thesis was very challenging because it has been developed by some newer technologies and by some technologies that have been longer around. It was quite intriguing to learn how to use those newer technologies and how to connect them all together. The technologies that were used are:

* ❖ For the front end or else User Interface: Vuetify
* ❖ For the management of the components and all the functionality: Vue.js
* ❖ For the Authentication of a User: Firebase
* ❖ For any other information: MySQL
* ❖ For installing any package for the project: Node.js
* ❖ For the connection with the database and creating a rest-API: Express.js
* ❖ For getting the data in the front-end with http requests: Axios.js

3.3.1 Vue.js

Vue.js is a JavaScript framework to create single-page application and user interfaces, it showcases an architecture that is incrementally acceptable and focuses on declarative rendering and component structure. Advanced characteristics needed for complicated apps such as routing, state management and building tools are available through formally maintained libraries and packages. Vue basically consists of HTML which is conventional markup language for browser-displayed websites, JavaScript(JS) a high level programming language that allows interactive websites and is a key component of web applications and CSS for checking and adding style to a document produced with a markup language.

Figure 15 Vue.js example

In CORE Vue.js it was the JS framework that was used to develop this application's front-end and started everything else. To build a VUE project you do it through NODE and after you install any other library you need.

3.3.2 Vuetify

Vuetify is framework for Vue JS 2.0. It intends to provide nice looking semantic and reusable components that help the process of building your application by making it a lot easier and faster. It uses the design pattern of Google's Material Design and other common frameworks like Materialize.css, Material Design Lite, Semantic UI, and Bootstrap 4. Vuetify is a Front-End Frameworks and an open source tool.

Vuetify was used in CORE to build all the components like the cards, timeline the buttons etc. Also it was used to style the elements like giving the color coordination in the timeline and help make the front-end more appealing for the user

3.3.3 Node.js, Express.js & Axios.js

Node.js or Node is a based-on Chrome's JavaScript Engine (V8 Engine), it's an open source served-sided platform that utilizes an event-driven, non-blocking I/O design that allows it to be compact and effective and ideal for real-time, data-intensive applications running throughout distributed systems. Applications for Node.js are developed in JS and can be operated on Microsoft Windows, OS X, and Linux within Node.js runtime, also offers a wide variety of JS libraries to greatly simplify web application development using Node.js.

Express.js or Express is a web application framework for Node.js that offers a solid set of web and mobile apps development characteristics. It promotes the fast growth of Web apps based on Node.

This application is responding with Hello World! for homepage requests. In any other case it will respond with a 404 Not Found

```
1    var express = require('express');
2    var app = express();
3
4    app.get('/', function (req, res) {
5        res.send('Hello World');
6    })
7
8    var server = app.listen(8081, function () {
9        var host = server.address().address
10       var port = server.address().port
11
12       console.log("Example app listening at http://%s:%s", host, port)
13   })
```

Figure 16 Express.js example

Axios.js or Axios is a very well-known JS library which can be used to execute HTTP requests that function for both Node.js and Browser

```
1    const axios = require('axios');
2
3    // Make a request for a user with a given ID
4    axios.get('/user?ID=12345')
5      .then(function (response) {
6        // handle success
7        console.log(response);
8      })
9      .catch(function (error) {
10       // handle error
11       console.log(error);
12     })
13     .finally(function () {
14       // always executed
15     });
```

Figure 17 Axios.js example

In CORE Node.js was used to create the Vue project and to install libraries and help with the overall development of the project. More specific Express.js and Axios.js are being used from Node to help in the development. With Express.js we created a Rest API that makes the communication between the MySQL database and the Back-end of the application. In this API the services were developed, and each service is executed wherever it is needed it. Now, Axios.js helps with the communication of the front-end with the Back-end through its calls.

3.3.4 Firebase

Firebase is Google's web and mobile application development platform that enables you to create, enhance and expand your application. Firebase is using a Realtime Database connecting through a WebSocket which are faster than traditional HTTP requests. Firebase also provides you with its own file storage and authentication

The first version of CORE was built with firebase, but after a better research of its capabilities and the limitation that it had the second version of the app kept only the authentication part. That will also change in the future and everything will migrate to a SQL database.
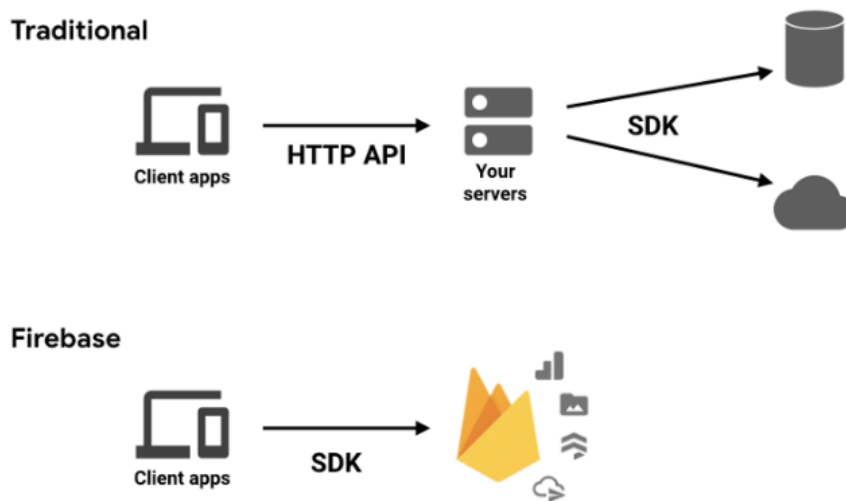
Figure 18

3.3.5 MySQL

MySQL is an open source RDBMS (Relational Database Management System) that's based on SQL (Structured Query Language) it basically operates in all the platforms such us Windows Linux and UNIX. MySQL is based on a model client-server. MySQL's core is MySQL server, that operates all of the database requests, it works with several utility programs that support MySQL database administration. Commands are given to MySQL Server through the MySQL client that is installed on a desktop. Nowadays, MySQL is the RDBMS that supports many of the world's top websites and numerous corporate and consumer-facing web-based apps, including Facebook, Twitter, and YouTube.

A big section of the second version of CORE uses MySQL database. MySQL was used to store all the user's information except his password, because its stored in an encrypted form in Firebase. Furthermore, it stores all of the values for the modules, lessons, chapters, and sections, it stores all the multiple-choice questions and the code questions for all the cases. And as we said the database communicates with the app through the Rest API.

Conclusion

In conclusion CORE was based on technologies which some of them were rather new like Vue, Node, Express and Axios and some technologies that exist for more than a decade and are proven to work not only because they have a lot of followers but because big companies use them. Technologies like that are MySQL and JavaScript. We said that JavaScript is a part of Vue but the reason that Vue is considered a new technology is because we see it as total. All these technologies appeared together and produced the outcome that we now know as CORE

4 Pilot implementation

In the previous chapter we described the design and analyzed parts of the application. In this chapter we will see visually how the application works in all its cases. Beginning with the Pilot Implementation Methodology followed by the Implementation of "User's Sign Up and User's Sign In" then the Implementation of "User's Educational Progress" and finally the Pilot use case scenarios. There will be two pilot use case scenarios that cover all the ways that a user is able to complete a course.

4.1 Pilot Implementation Methodology

After the design and analysis of the system took place and the description of the UML diagrams, it was time to begin developing the application. Towards the begging of the thesis the concept was to create a web-based serious educational game that would help you learn Java but because of some circumstances the thesis plan sidetracked, and a distance-learning tool was created instead. So, starting the idea, was to write code and whatever changes would be made, there would be changed in the same file. Thinking about this idea there were some flaws, not by having a file project, but not having backups of the project and if there was a need to go back to get something, it would be impossible. So eventually GitHub was introduced to the project, github helped track the most recent changes that were added and committed to the file project, it also helped to use it because now the developing could be done from anywhere it was needed, just by uploading it and afterwards by downloading it.

As developing the project, Firebase was used for the database portion of it. Firebase was used because it's a NoSQL type of base. It's fast correspondence and responsiveness with all the components was very satisfying and the services already existed. So, the only thing to do was to use them. But after some development meetings, the decision of changing the firebase was made as result of some limitation that appeared in a free user account. Following on that, a second version of the application was created and wherever firebase services where used, they were replaced with MySQL except the authentication part. Thus, now there where two version, one with complete firebase structure and the other with MySQL. The first version eventually was left at the state that it was last modified and the other with the SQL database was used to continue the development. The same tactic as before was used by creating a new repository on the GIT for the second version and the development continued.

To summarize, there are two versions but only the second one is fully supported and being updated, as the development goes on and the first one was essentially abandoned.

4.2 Implementation of "User's Sign Up and User's Sign In"

This subchapter will showcase the implementation of how the user can sign up and how to sign in in the application. Before we show those parts, the app has a home page as seen in the Figure 19 which has some small info and acts at the application main page that can be seen always even if you are not logged in.
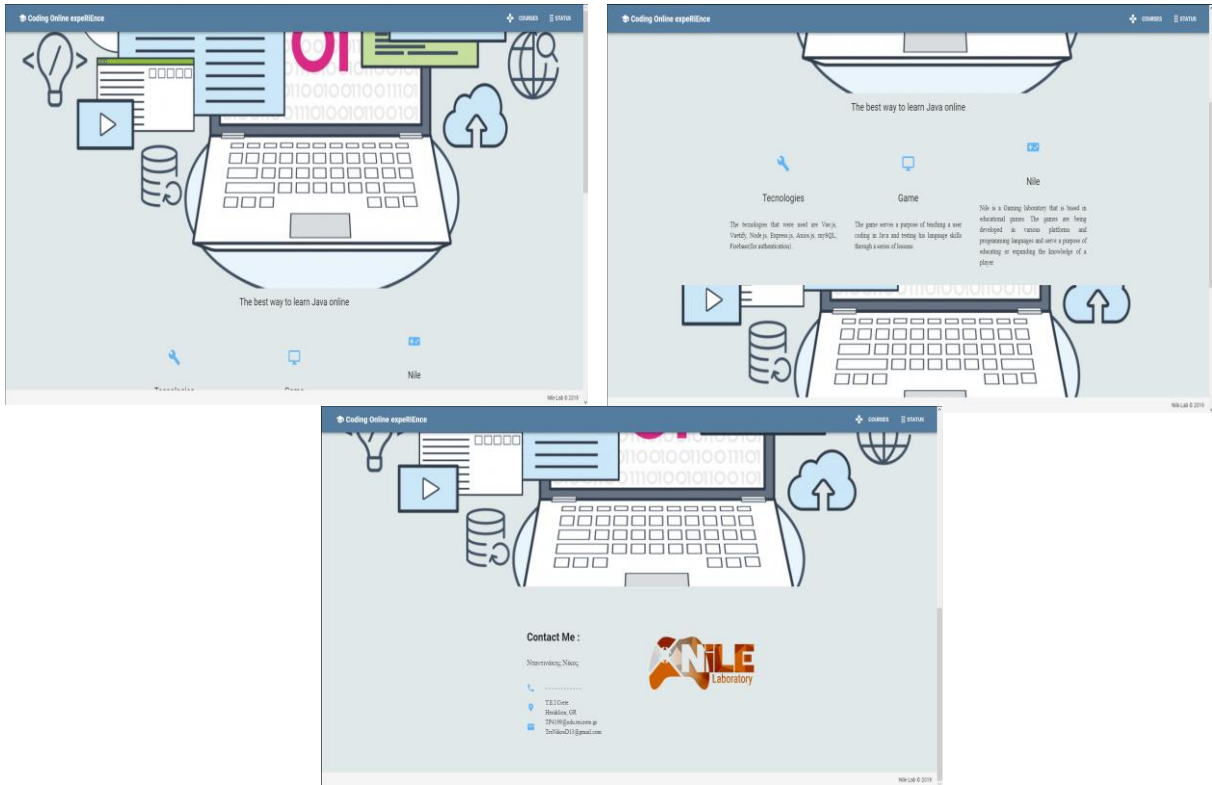
Figure 19 CORE Home Page

User Sign Up

If a User isn't registered, he will go in the up-right corner and click STATUS and then he has to click the Sign Up. The user will be redirected to the register page, where he must fill out the registration form that in following order will demand his Name, Surname, E-mail, Password and Confirm Password. For him to register properly the two passwords must be the same and above 6 characters and the E-mail must not already exist in the database. If those terms are fulfilled, then he will automatically be logged in an he will be able to use the app from this point on. This procedure can be seen in Table 2.

(a)   (b)

(c)   (d)
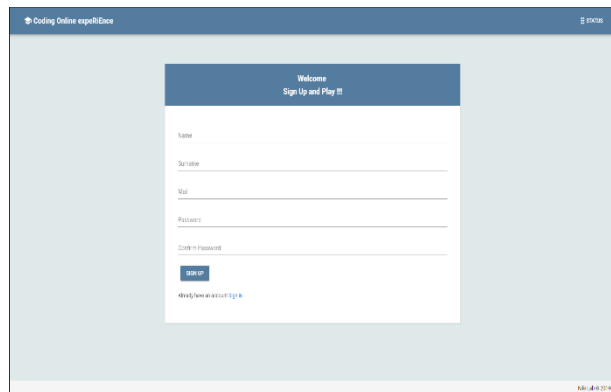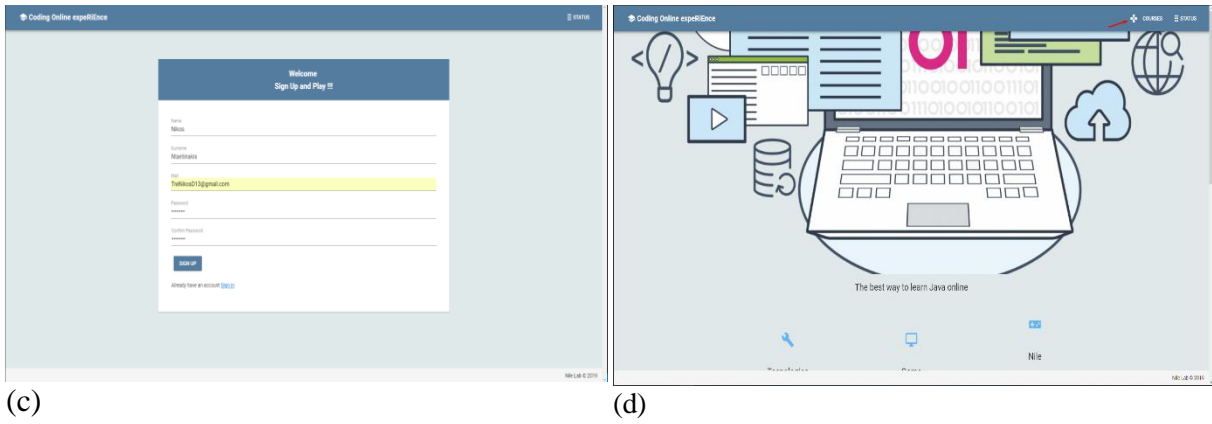
Table 2 Register User

User Login

If a user is registered all he must do is to login, once again he must go to the top-right corner and this time click the Sign In. Once this is done, he will be encountered with the Sign In form. Afterwards he fills out the Sign In form by entering the E-mail that he used and his password considering that both exist in the Firebase to authenticate, then by clicking sign in he will be logged in the application and have access to the course and any other features. This procedure can be seen in Table 3.

(a)   (b)

(c)   (d)
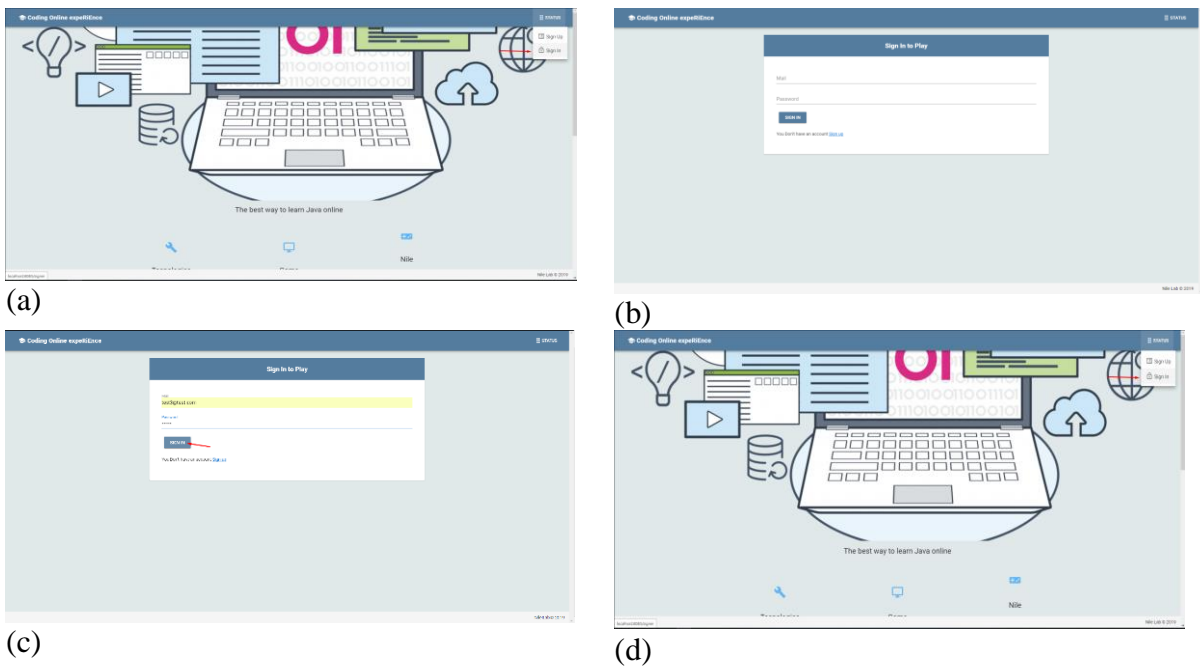
Table 3 User Login

4.3 Implementation of "User's Educational Progress"

A user can have many progress states that are going to be described. He can be a new user, so he essentially hasn't begun the course at all, he can be somewhere between the beginning and the end of the course, or he has finished the course.
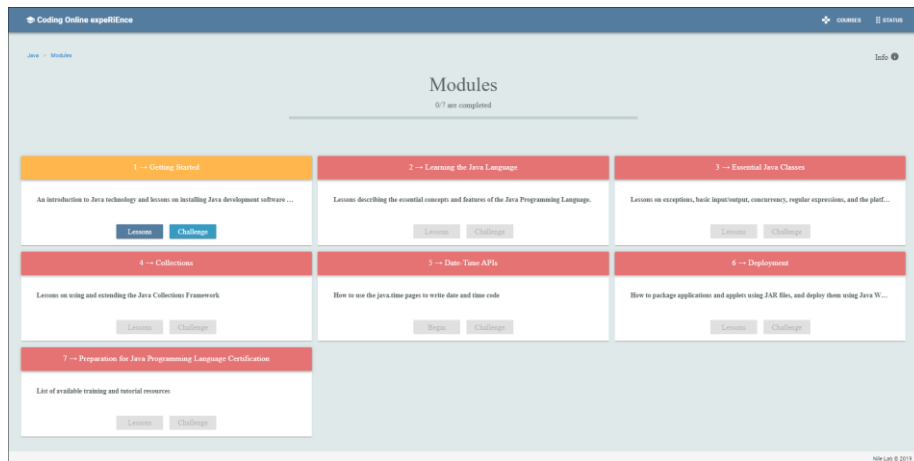
Figure 20 User just begun the course

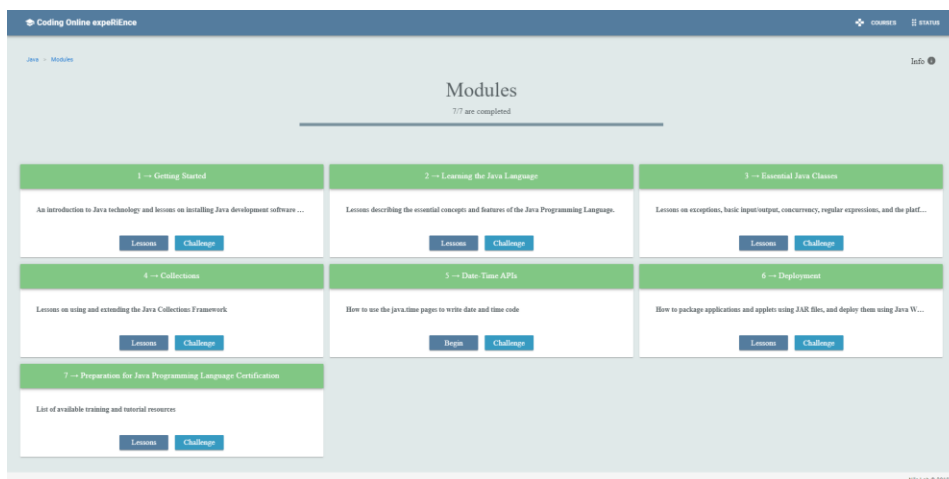*Figure 21 The user is somewhere intermediate in the course*

Figure 22 User has finished the course

Now as you can see in the Figure 20, Figure 21, Figure 22 they all have something in common. In all of the figures the progress state of the user is color coordinated. This is done so the user can understand were he is in the cours,e what he has left, what is completed and what is needed to be completed to move on so he can finish the course. If we take a closer look at Figure 21 we can see all the possible states that a user can be in. The green color represents something that he has already done and finished with, the orange color represents the state that the user currently is in and has to accomplish so he can move on and at last the red color represents something he

hasn't done and something that he has to do if he wants to finish the course. But to do so, he first has to complete the module with the orange color.

The color representation exists also in the Lessons, Chapters, Section as you see in the Figure 23 to ensure coherence in the program. The only difference is the way that the cards are displayed, they are now displayed in a timeline, so the user can follow the flow of the course.
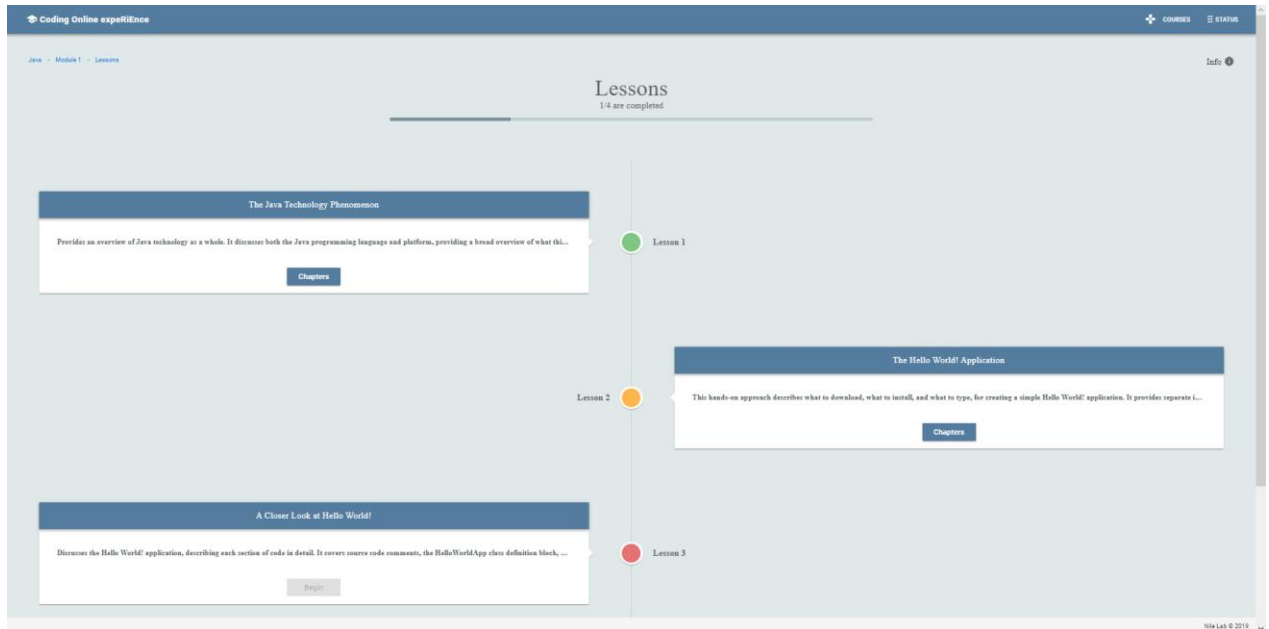

Figure 23 Example of color representation in a Lesson
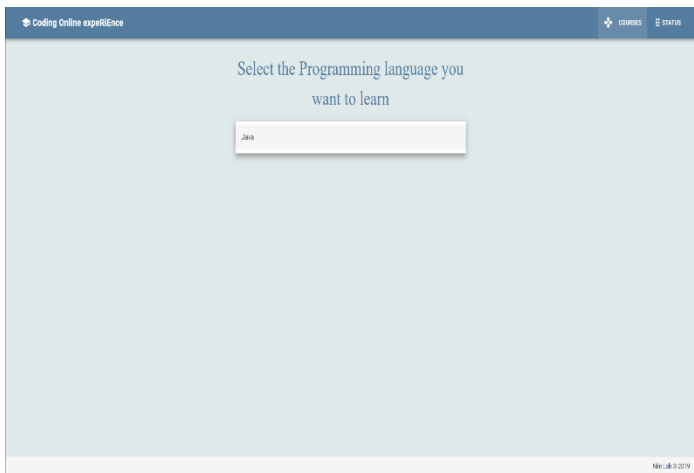
4.4 Pilot Use Case Scenarios

As we have expressed in earlier chapters, the user can complete the course in two different ways. These ways will be described in two different Use Case Scenarios for a better understanding. After the user has logged in and clicked the course in the top-right left to the status, he will be able to choose the course that he wants to procced with, for the time being the application supports only one course, Java. Afterwards he has to choose how to move on, either by beginning the course or completing it at once. In the Table 4 you will see the procedure until this point.
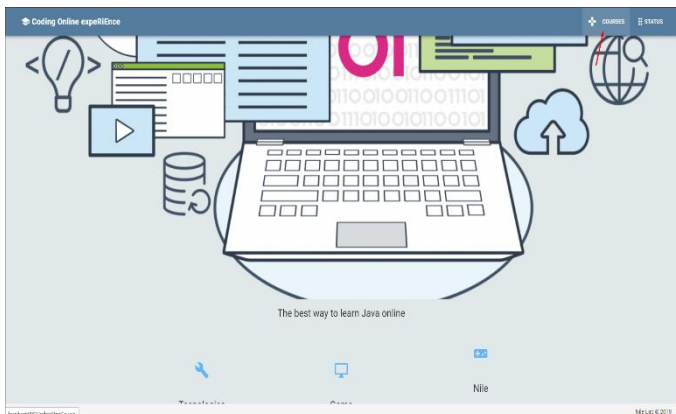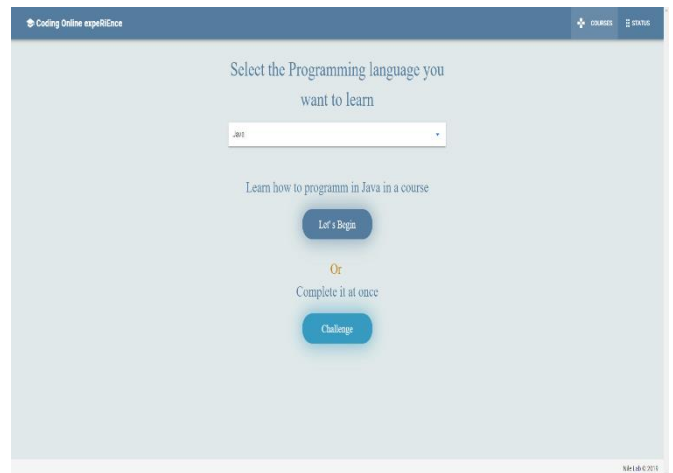

(a)
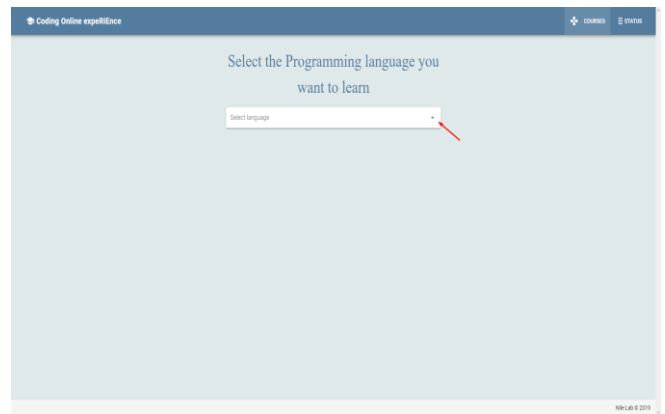
(b)

(c)   (d)

Table 4 Path to course

Later on when the users reach this point like shown in Table 4(d) here is the point where the use case scenarios appear.

1. User completes the course with its normal flow
   a. User completes a whole module
2. User completes the course at once

In the following sections we elaborate on the above described scenarios of use.

4.4.1 User completes the course with its normal flow

The first pilot case scenario showcases the intended way of a e-learning or distance learning application. That means that the user will follow all the steps to complete the course, the user will navigate through all the possible modules, lessons, chapters and sections until he reaches the end. As described in chapter 4 not all the modules have lessons, not all the lessons have chapters and not all the chapters have sections. So, when a stage has no subsequent phase, then it starts the Lecture and exercise process. As you see in Figure 24, in Module 5 (Date-Time APIs) if there are no lessons it means that it will go straight to the lecture and exercise parts, thus when the button says "Begin" it doesn't have a next stage and it goes to this part of the course. This is the way to determine whenever you have to complete the lecture and exercise portion.
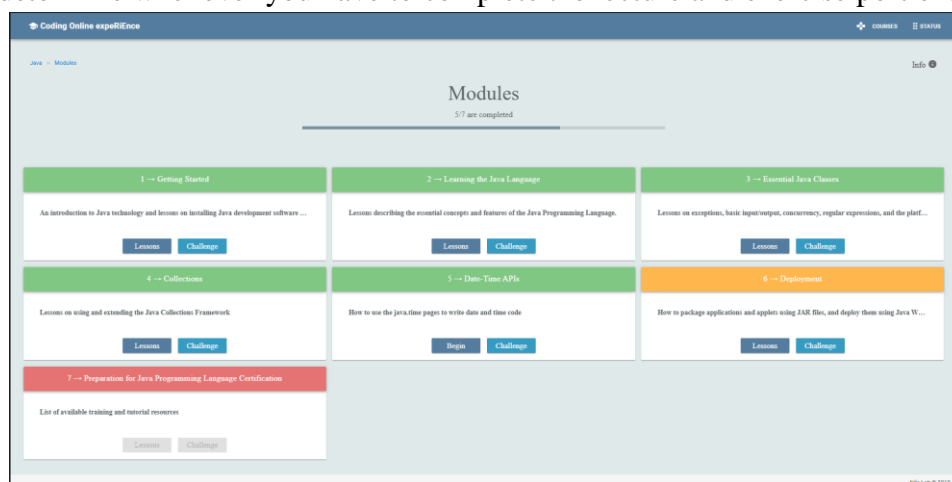

Figure 24 Module

As you will notice through all the modules, lessons, chapters, sections pages near the top right corner there is an info sign, if you hover over it you will get some information about the page you are in like in Table 5.
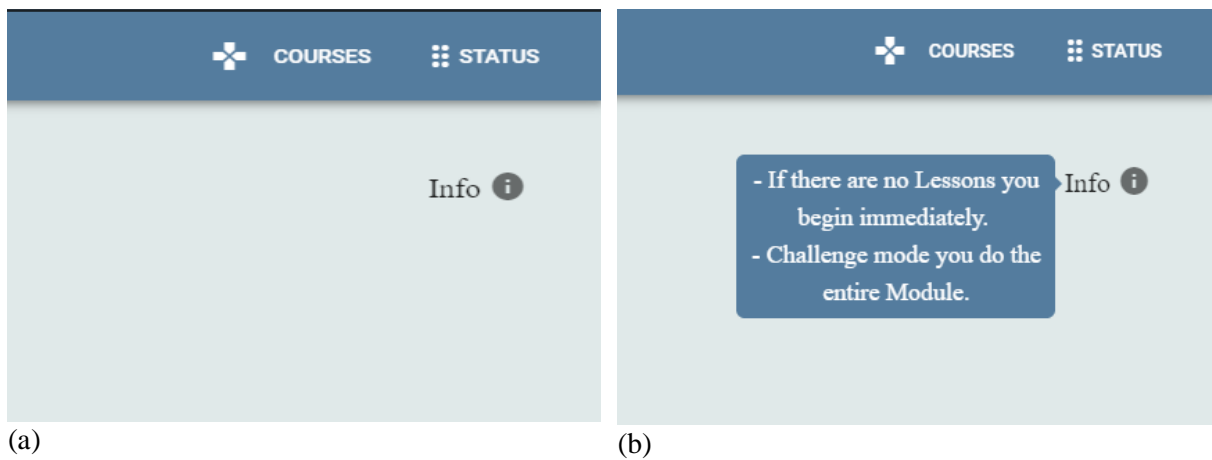

(a)   (b)

Table 5 info example

Throe all the stages you will find a progress bar and a numbered fraction, depending in whatever page you find yourself in. Those three indicators will let you know where you are, how much you have done and how much you have left to complete the lesson.

Further at the top left corner you have a navigation helper to see how deep you are in a specific module, lesson etc. an example is set at Figure 25.
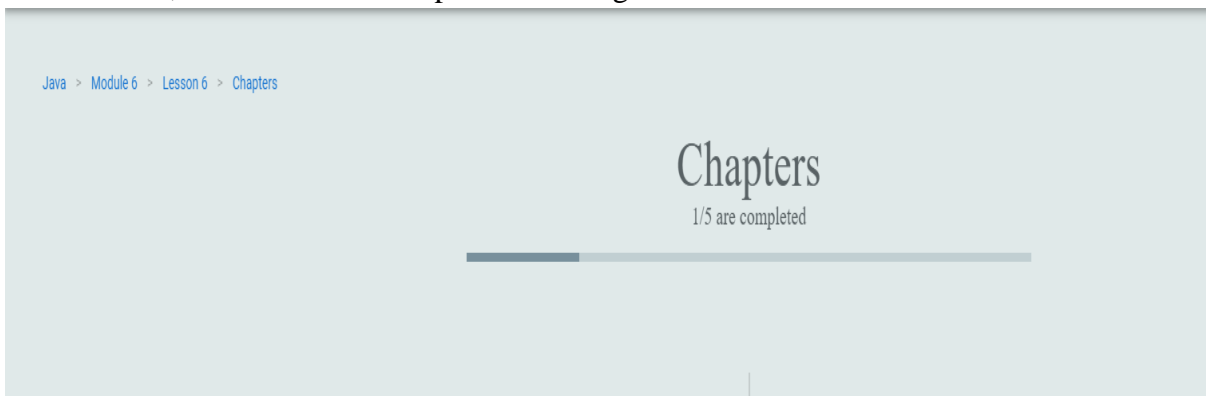

Figure 25 progress bar, navigation helper

Now, for example lets say we navigate through "module 2 > lesson 2" and we press "Begin" at the Chapter 3, the first thing we are going to see is the theoretical part, the Lecture part as seen in the Figure 26. The Lecture part consists of the theory that is presented in a pdf like format and a button to move to the exercise portion. Again, the pdf-lecture part is taken from Oracle java documentation to make the experience o learning java more accurate.
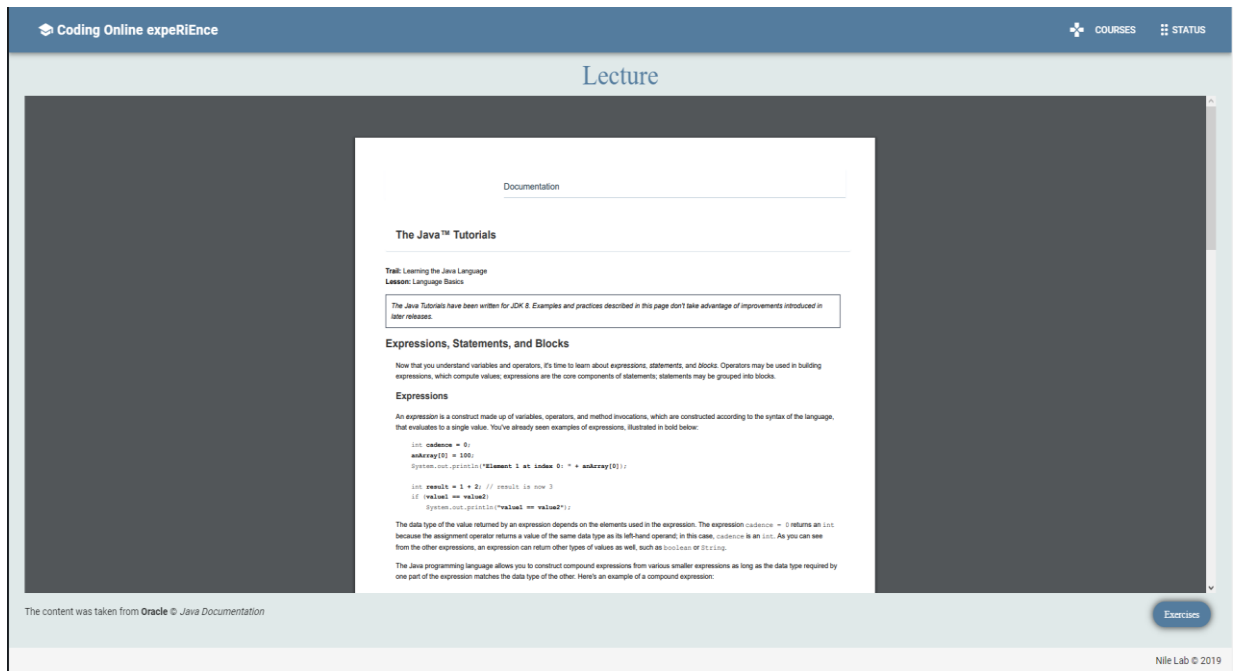
Figure 26 Theoretical part/Lecture

After the user feels comfortable about the theory he can procced to the Exercise part by clicking the button. Then he will be confronted with two tabs. One holds the multiple-choice questions Figure 27 and the other one has the program part Figure 29. All the content is relevant to the lecture part, but there is a possibility that the exercise portion doesn't have multiple choice questions and or the code part. Now if the multiple-choice question exist the user must finish them if he wants to be done with the lecture. As the application is running right now, for the code part of the exercise it doesn't check if the user wrote the appropriate code so the user can proceed without it, but for his own good he should complete it. Except for the embedded compiler that the application uses there is also an external link for another web-compiler in case the first one doesn't work, but also if the user wants he can write his program locally in an actual development environment like NetBeans or Eclipse. If both parts don't exist, the user presses "Done" and continues to the next Lecture.
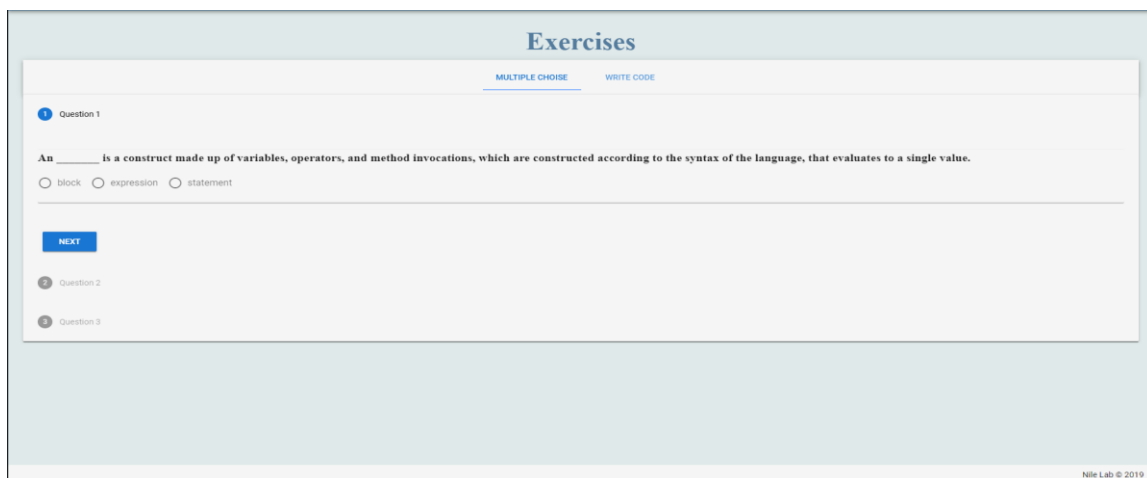
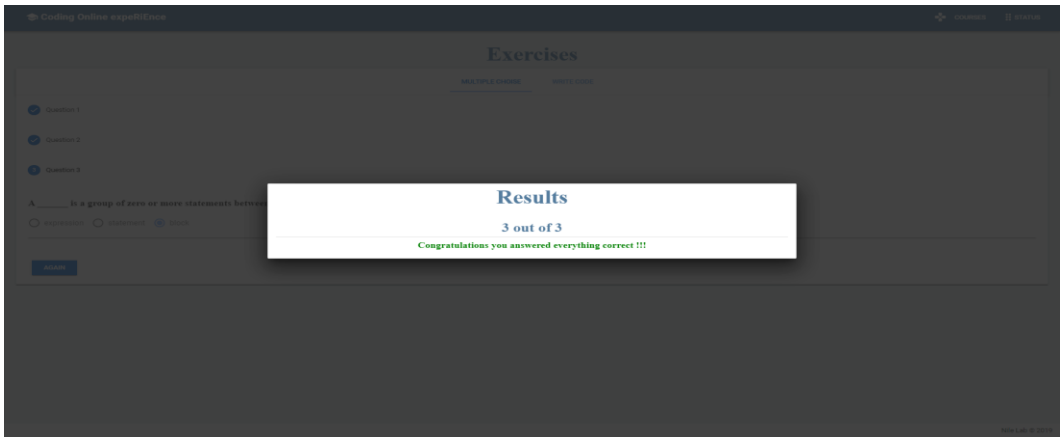

Figure 27 Multiple-choice example
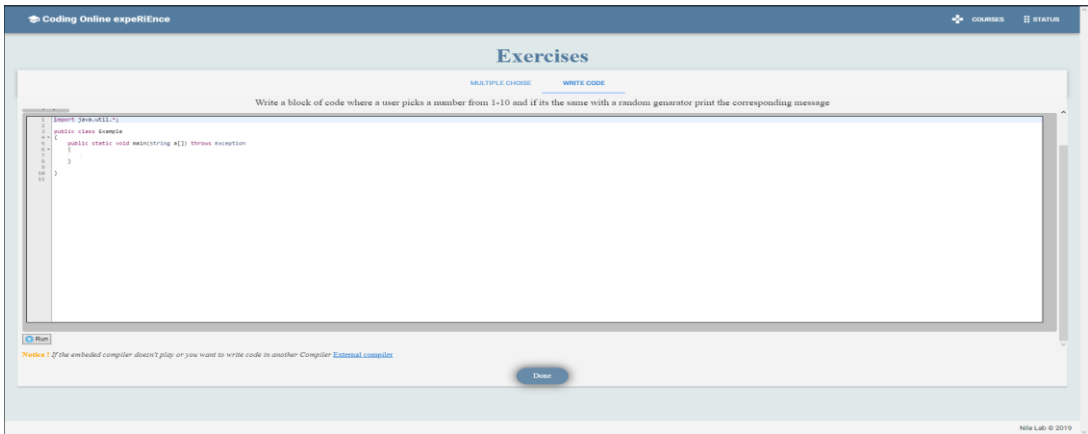
Figure 28 multiple-choice completed

Figure 29 Write Code example

User completes a whole module

As you seen in Figure 24 when the user is located at the Module page he has the option to complete an entire module at once. This means the user doesn't need to get through the lessons, chapters and sections if they exist. Completing a module at once doesn't mean that the user must complete them all at once. If a user feels that he knows a certain module very well then he can challenge it. By challenging a module, the theoretical part will not take place, only the exercise ,that its structure is the same as it would appear in a normal lesson. Completing a whole module at once you will have questions from all over the particular module. A preview of challenging the module 2 on Table 6.
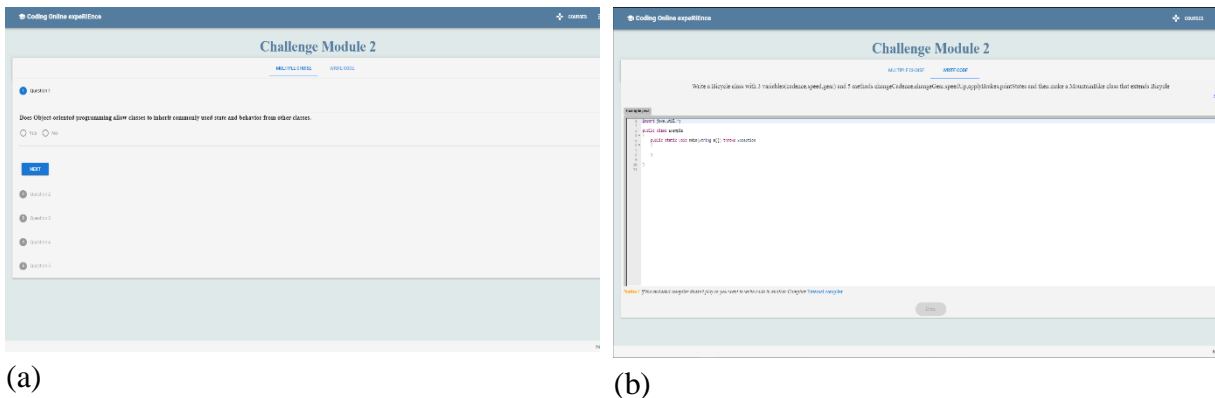

(a)

(b)

Table 6 example on Challenge Module 2

4.4.2 User completes the course at once

The second Pilot Use Case Scenario shows that you choose to complete the course at once. If we go back to Table 4(d) we will see again that the user is faced with two options. This time the user chooses to complete the course at once. That means that the user doesn't have to go through any module to complete the course which also means that the user is confident enough and doesn't need to view any theoretical Lecture. The Complete course at once can be done in any point that the user wishes to do so, even if he has started to complete the course in its normal flow of events. Once again like the "complete the whole module" this consists only from the exercise part that includes questions from all the modules and a program to satisfy all the modules. A preview on how the structure is in the Figure 30, Figure 31.

Figure 30complete course at once multiple-questions

Figure 31 complete the course at once code part

5   Conclusion & future work

The Final chapter of the thesis contains a few words about the conclusion and some future work that will be done eventually.

5.1 Conclusion

Taking everything into account this thesis was pretty interesting to develop. Distance education platforms are not a new concept but because the growth of online learning they are something to invest in. Distance learning and e-learning platforms are being used from universities to schools to even big companies. Building the application was challenging with a lot of decisions to make that didn't always end up great.

   In conclusion the application is trying to teach anyone the java programming language thrue a series of events. Its referred to any kind of programmer, from an experienced one to a rookie. Finally, once you complete the course you will have learned the basic principles of Java and you will be able to write your first real Java application.

5.2 Future work

Developing a website is not an easy tas,k especially a distance learning platform. In order to create a web application, it takes a lot of time and thinking from analyzing to designing to implementing to finally developing the application. Because the time frame had already been exceeded, the application that was presented here is not in its final stage. CORE didn't get out of track but there were things that could be programmed differently.
The features that have to be changed are:

- Authentication. As mentioned in previous chapter the application was originally designed with firebase, a NoSQL type of base. Because as said we changed to MySQL the authentication staid for convenient reasons. So, one of the goals is to make the authentication through MySQL.
- Redesigning the database. Once again because the database is not designed optimal a reconstruction will have to be made.
- Right now, there are two ways to write a code. Through an embedded compiler or by clicking to a link and being redirected to another web compiler. Nor the embedded compiler or the external are supporting Java Swing which lets you design a Graphical User Interface (GUI) so another goal is to somehow find a java web-based compiler that will support Swing.
- Another feature is that the compiler doesn't check the code. So, in time being the users don't have to complete the code if they don't want. Therefore, one more goal is to somehow check if the user wrote the appropriate code.
- Another thing that need redesign is the multiple-choice, and also some methods and services.
- Furthermore, the questions themselves from the multiple-choice were picked kind of

randomly so a deeper search in the Oracle Java tutorial has to be made.

- Reward system is one more thing that would be nice to be added to the tool, so the users can be rewarded any time the complete something successful
- In the time being the application supports only one language Java. One of the ambitions is to support multiple programming languages
- Another big target is to introduce the teacher mode. Essentially the application will support two different types of users, the student and the teacher. Right now, all the attention of this application is going to the students. The teachers will be able to see the progress of the students and be able to change any part of a the course if they want.

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