# CHAPTER III

# RESEARCH METHODOLOGY

Each section discusses the approach to be used for the analysis and other technical specifications to help reinforce the proposal. It also includes diagrams, designs features techniques and materials for implementing iLearnCentral: a cloud-based learning center platform with mobile technology to fulfill the study's goals requirement.

## Software Engineering Methodology

iLearnCentral's development study will use the agile approach as the project framework for software engineering. Agile software development defines an approach to software development under which requirements and ideas progress through the collaborative effort of cross-functional self-organizing teams.

One of the benefits of the agile approach that suits this study is collaboration and open interactions to designers, advisors, and collaborators based on their feedback and any changes that occur throughout the development. This promotes flexible planning, structural growth, first conveyance, and ongoing transition, and facilitates rapid and adaptable change response.



Figure 2: **Agile Development Methodology**

Figure 2 shows the representation of the framework lifecycle in an agile development methodology. The agile process requires less preparation and the activities are split into small increments. Agile process is designed for short-term projects with a team effort that meets the life cycle of software development (Sharma, 2012). By using customer feedback to agree on ideas, iteratively improves software This approach provides opportunities for assessing the path throughout the development lifecycle This is achieved by generic workflows, such as sprints or cycles to the end of which teams will deliver a material increment that is potentially transmittableThis approach focuses on the replication of abbreviated work cycles and the practical yield of the material.

The developers did the following phases of the Agile Methodology:

**Requirement Analysis.** Define the requirements for the iteration based on the product backlog, sprint backlog, customer and stakeholder feedback.

The system features are gathered for this section by conducting research, interviews with industry experts specifically in the related fields. The UI designer and the programmer must define the code specifications needed to fulfill the requirements of the project. The technical writer should take note of the changes that have been made. It will then be checked by the technical writer with all team members. The database designer will then verify if the features are compatible with the materials. The project manager must report the improvements made by the team to the team's advisor.

The team members assigned to work on the obstacles will analyze the issue for the next iterations and come up with a possible solution. They will consult on possible solutions with the other members. At the end of each day, the team members will report on their progress.

**Plan Phase.** Phase of preparation involves creating a set of plans that helped guide the team through the phases of project implementation and closure. The plans produced during this process helped developers manage time, cost, performance, change, risk, and issues to ensure the project was delivered on time and within budget by the developers.

**Design Phase.** The specifications evaluated and defined by the designers were used in the design phase to make design choices using various diagrams. The user interface will be designed by the UI designer The programmer and database designer must describe the device element interface mechanism. The project manager will monitor the progress of the members ' tasks. The researchers must describe the various hardware used for the project in this process.

**Development Phase.** In this step, usability and reliability will be tested for all aspects of the product. The software will be tested if it meets all the requirements set out in the evaluation of requirements and if it handles the information correctly.

The developers checked the software, analyzed it, and identified the issues and updated or modified the issues beyond the steps or requirements that were set up. Until deployment, every part of the operation underwent a continuum of individual evaluation through different testing methods to ensure its efficacy and efficiency.

**Release.** Before releasing it to the market, developers carried out several activities to test the device and the application in order to pass through the process required. It allows the system to work within each operation of the deployment phase with tolerable performance and specific processes. Using the guidance given in the deployment document developers then installed the application in the server environment.

**Track and Monitor.** After the program was sent out to the customers / clients in this process. Developers maintain tracking, monitoring, and providing IT support services to include system and software updates and enhancements if appropriate.

## Planning/Conception-Initiation Phase

High-level decisions on why a project is needed, whether it can be completed or not, and what is needed are taken in this segment. This helped the researchers keep track of their assigned tasks in meeting the specified deadline, the progress of each requirement and task, and the budget for project work plans.

## Business Model Canvas

The Business Model Canvas is a visual representation, commonly used by strategic managers, of existing and emerging business models.

**Table 2**

BUSINESS MODEL CANVAS

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Key Partners** | **Key Activities** | **Value Proposition** | | **Relationships** | **Customer Segment** |
| -Learning centers administration  -Educators currently teaching in learning centers  -Job seeking educators | -Design and develop an intelligent school management software geared towards the needs of learning centers, educators, students | - System can be used by any type of learning center  - System could automate basic operations of administration with integrated artificial intelligence  - System has additionalsupport to the educators and students | | - Customer service hotlines  - User Feedback  - Email | - Learning center administration  - Educators in learning centers  - Students in learning centers  - Educators seeking employment |
| **Key Resources** | **Channels** |
| - Web domain and host  - Developers  - UI/UX designers  - Researchers | - On-location Visits  - Company Website  - Social Media Marketing  - Word of mouth |
| **Cost Structures** | | | **Revenue Streams** | | |
| - Customer acquisition costs  - Research and Development  - Marketing and Advertising  - Hosting, Operations and Maintenance | | | - Subsciption based on feature packages  - Ad Revenue from free or trial users | | |

Table 2 illustrates the system’s Business Model Canvass. To build a successful business market, the Business Model Canvass is essential This will give concrete ideas to the researchers about the target market of the project and the cost of developing it. Value ideas should demonstrate the system's need and show the public its value. Channels are a way for the group to interact simultaneously with customers and investors to sell the program. Customer relationships will ensure that the entities involved are supporting our business relationship, and revenue streams will demonstrate how we can earn revenue from the products and services provided.

## Program Workflow

Defining, managing, automating and optimizing business processes is a software workflow. Progressions of measures (tasks, events, interactions) involving a cycle of work, involving two or more individuals, and generating or adding value to the activities of the organization.



Figure 3: **User Activity Program Workflow**

Figure 3 shows the program workflow for general user activities. The administrative account creation and authentication starts with the registration of learning centers to the system. Job seekers register for an account to build their profile resume. The hiring module involves the learning center and job-seeking educator which could produce an employed educator. Only learning center and employed educator accounts can log in to most of the functionalities of iLearnCentral. Interested students/parents can inquire by creating a free account and browse through services offered by learning centers. Enrolment would involve input from both learning center and the student/parent. The scheduling is processed by iLearnCentral to produce calendars and notification to the employed educator and student/parent.



Figure 4: **Hiring Module Program Workflow**

Figure 4 details the hiring module from Figure 3. Job-seeking educators build their hiring profile or resume. After which the system processes their qualifications and determine a list of hiring learning centers from open job vacancies on which they apply for. They can also browse through other job vacancies available. On the other hand, learning centers receive recommended list of job-seeking profiles which fit their requirements.



Figure 5: **Enrolment Module Program Workflow**

Figure 5 shows the program workflow for the enrolment module. The student or parent will see a course list from the system provided by the chosen learning center. With the selected course/s, they can process enrolment by providing the required information. The system will calculate fees needed with the student/parent choosing methods of payment. Offline payment goes directly to the learning center, who would then record the transaction. Paying online is an option using various methods of online payments.



Figure 6: **Scheduling Module Program Workflow**

Figure 6 shows the workflow for the scheduling module. The administrative staff would input class details for scheduling. The students and educators have time available when they can have a class. Schedules depend on matches with class courses and educator’s open loads. There should be a consideration for the classrooms available and the learning center’s open business hours. Any changes to the schedule should automatically adjust schedules and notify all persons involved.



Figure 7: **Teaching Assistance Module Program Workflow**

Figure 7 shows the program workflow for the teaching assistance module. It involves assisting educators with their day to day activities, including lesson plans, record keeping, and tracking student's progression.

## Validation Board (Stages 1 and 2)

Table 3 shows the different problems that our customers encountered. It also shows the solution to the problem being solved by the researcher. Table 3 also contains the most risky assumption, the methods and the criteria for success, the results and the decision, as well as the learning.

**Table 3**

VALIDATION BOARD

|  |  |  |  |
| --- | --- | --- | --- |
| Experiments | 1 | 2 | 3 |
| Customer | Learning Center Administration | Employed Educator | Job-Seeking Educators |
| Problem | Small and medium learning centers still using manual transactions to support common management processes i.e. hiring, enrolment, and scheduling | Variation of lessons for different students handled, maintaining schedules, and keeping records | High turnover of educators in learning centers leading to constant demand amidst particular qualifications. |
| Solution | A dynamic learning center management system supporting different types of learning centers, i.e. day care, music, language studies | Adding a module for educators employed by a center to keep track of lessons, update schedules, and integrate records to the system. | Data pool of job-seeking educators sifted and recommended to fit learning centers' particular needs and vice versa. |
| Riskiest Assumption | Learning Center have no IT support | Learning center provide resources i.e. internet connectivity to employees | Educators uses the system to look for employment in learning centers |
| Method and Success Criteria | Interview | Interview | Survey |
| Results and Decision | Persevere | Persevere | Persevere |
| Learning | Learning centers differ considerably with provided services and management procedures. However, some similarities occur, such as hiring, enrolment, and schedules, giving them commonality. | Educators can follow standard lessons or build theirs based on it. But with variable student levels, they should keep track of progress for each under their purview. | Most job-seeking educators join learning centers to gain experience for higher-paying jobs. They are less likely to stay with learning centers offering low salaries leading to them finding other opportunities. |

## Gantt Chart / PERT Chart

This section presents a Gantt chart showing the work done or activities completed in specific time frames in relation to the amount planned for the specified periods. Every activity is performed in three different colors: red means that the activity is still incomplete, yellow means that the activity is still on the way, and green means that the activity is already finished. The chart serves as a guide for the advocates to decide how long a project will take, classify the resources needed, and schedule the order in which the complete tasks of the researchers are to be performed.

**Table 4**

GANTT CHART

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Task ID | Task Name | Task Lead | Start Date | End Date | August 2015 | | | | September 2015 | | | | October 2015 | | | |
| 1 | 2 | 3 | 4 | 1 | 2 | 3 | 4 | 1 | 2 | 3 | 4 |
| 1 | Title Consultation |  | Aug 16 | Sep 16 |  |  |  |  |  |  |  |  |  |  |  |  |
| 2 | Project Proposal recommended |  | Sep 16 | Sep 16 |  |  |  |  |  |  |  |  |  |  |  |  |
| 3 | Discussion with adviser | Jephunneh | Sep 19 | Sep 23 |  |  |  |  |  |  |  |  |  |  |  |  |
| 4 | Preliminary research of the project | Cristian | Sep 23 | Sep 26 |  |  |  |  |  |  |  |  |  |  |  |  |
| 5 | Writing of Chapter 1 | Cristian | Sep 23 | Sep 26 |  |  |  |  |  |  |  |  |  |  |  |  |
| 6 | Consultation with adviser on Chapter 1 | Jephunneh | Sep 27 | Sep 27 |  |  |  |  |  |  |  |  |  |  |  |  |
| 7 | Preparing of Transmittal Letter/s | Rhea Shane | Sep 16 | Sep 23 |  |  |  |  |  |  |  |  |  |  |  |  |
| 8 | Preparing of Questionnaires | Rhea Shane | Sep 16 | Sep 23 |  |  |  |  |  |  |  |  |  |  |  |  |
| 9 | Interviews/Surveys | Rhea Shane | Sep 23 |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 10 | Finalizing of Chapter 1 | Cristian | Sep 27 | Sep 28 |  |  |  |  |  |  |  |  |  |  |  |  |
| 11 | Writing of Chapter 2 | Cristian | Sep 29 | Oct 2 |  |  |  |  |  |  |  |  |  |  |  |  |
| 12 | Consultation with adviser on Chapters 1 and 2 | Jephunneh | Oct 2 | Oct 2 |  |  |  |  |  |  |  |  |  |  |  |  |
| 13 | Finalizing of Chapter 2 |  | Oct 2 | Oct 4 |  |  |  |  |  |  |  |  |  |  |  |  |
| 14 | Writing of Chapter 3 | Rhea Shane | Oct 7 | Oct 17 |  |  |  |  |  |  |  |  |  |  |  |  |
| 15 | Consultation with adviser on Chapters 1, 2, and 3 | Jephunneh | Oct 18 |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 16 | Consultation with Technical Editor | Rhea Shane | Oct 18 |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 17 | Writing of Initial and Final Pages | Jephunneh | Oct 14 |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 18 | Final consultation with adviser | Jephunneh |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 19 | Compiling and finalizing of Manuscript | Rhea Shane |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 20 | Poster design & preparation | Cristian | Oct 17 |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 21 | Presentation preparation |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 22 | Proposal presentation |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |

## Functional Decomposition Diagram

This section demonstrates the functional relationship between the various components of the decomposed project into critical modules to clearly illustrate and simplify various activities.



Figure 8: **Functional Decomposition Diagram**

## Analysis / Design Phase

The stage of analysis includes the concept of the specifications needed to accomplish the method. Each step determines the problem to be solved by the customer.

## Use Case Diagram

Use case diagram shows the graphic representation of the mechanism of iLearnCentral and potential sequences of interactions between systems and users in a specific environment related to a specific target.

Figure 9: **Use Case Diagram**

Figure 9 shows the use case diagram for iLearnCentral. It shows the outside view of the system and the requirements needed. It identifies the system's influencing external and internal factors and their interactions.

The learning center is a factor in most of the internal modules. Account management involves all actors with varying degrees of complexity for each actor. Job hiring only concerns with the learning center and the job-seeking applicant. Enrolment processing is between the learning center and the students/parents. Determining schedules need the interaction between the learning center, student/parent, and assigned educator. Lastly, teaching assistance is a module for employed educators to utilize.

## Storyboard

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## User Interface Diagram

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## Database Design

The database to use is NoSQL due to the advantages it provides with data volume, velocity, and variety. It allows for better adaptability to changes in schema when using agile development. It is scalable and accessible to multitudes of users, which is necessary to a cloud-based system.

This section shows the designed NoSQL schema. The designing process follows the Query Driven Design that optimizes access instead of storage. It is by no means the final structure of the schema as changes will arise during the development process.

## Entity-Relationship Diagram

This segment shows the relationship between iLearnCentral entities involved.

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## Data Dictionary

This section describes the types of data, properties and field sizes shown in the tables in the previous section.

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## Network Model

The model of the network shows how the system components communicate via the internet. The diagram shows that the user is able to check and monitor their account through application for possible breaches or errors.



Figure 24: **Network Model**

Figure 24 shows the network model of the system. Internet is used for both web and mobile app to interact with the database.

## Network Topology

The network topology illustrates how the system's hardware and software component work in conjunction with the use of internet connection to access the user's access database.

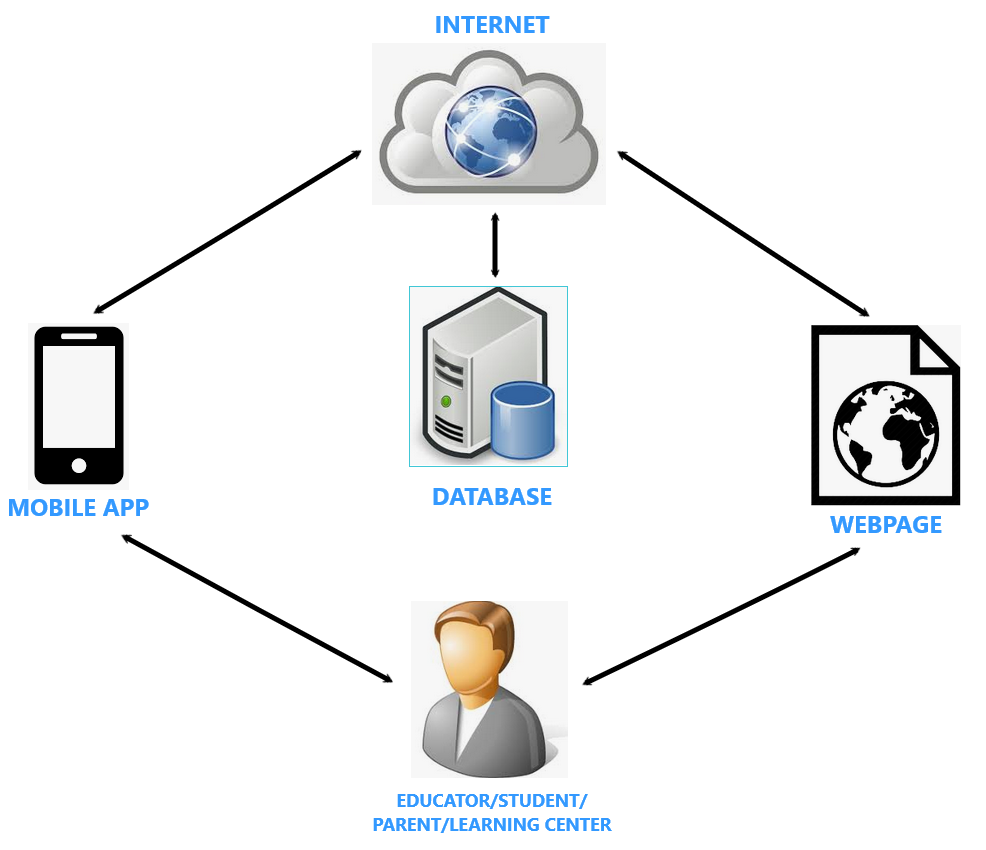


Figure 25: **Network Topology**

Figure 25 shows the network topology of the system. As shown the user can use both web and mobile app with the help of the internet. They can manage classes, check schedules, post and search jobs, etc.

## Development/Construction/Build Phase

The Development Phase marks the end of the initial process segment and marks the beginning of development. This phase is intended to turn the prototyped system design in the Design Phase into a working system that meets all defined system requirements. Two elements are required to complete this phase successfully: 1) a complete set of design specifications and 2) proper processes, standards and tools.

## Technology Stack Diagram



Figure 26: **Technology Stack Diagram**

**Technology Stack for Mobile**

**Android Studio** is an integrated development environment for the Android operating system. It was built on JetBrains' IntelliJ IDEA software and designed for android development. It comprises both frontend and backend development by using XML and java.

**XML**,meaning eXtensible Markup Language, is a markup language built as a standard way to encode data in internet-based applications. Android uses it in creating layouts and components as Front End for typical applications.

**Java** is one of the languages used in android development. Java's mobile version is called Java ME. Many smartphones and tablets support it. The Java Platform Micro Edition (Java ME) provides a flexible, secure environment for building and running applications that target embedded and mobile devices. Java ME addresses the challenge of running applications on devices that are low on memory, display, and power available.

**Technology Stack for Website**

**ReactJs** is a JavaScript library that is declarative, powerful and scalable to create user interfaces. This allows complex UIs to be constructed from small and isolated pieces of code called "components."

**Bootstrap** is a free and open-source front end development platform for website and web app construction. The architecture for Bootstrap is based on HTML, CSS, and JavaScript (JS) to promote the development of responsive, first mobile sites and apps.

**HTML**, or HyperText Markup Language, is the standard markup language for creating Web pages. It describes the structure of a Web page. Consisting of a series of elements or tags, it tells the browser how to display content.

**CSS**, short for Cascading Style Sheets, a new feature introduced to HTML that provides more control over how pages present to both website developers and users.

**JavaScript** is a scripting language on the client-side. It means that the web browser of the client interprets the source code instead of the webserver. JavaScript functions can run without interacting with the server after a web page loads.

**Node.js** (Node) is an open-source framework for the server-side execution of JavaScript code. Node is useful for developing applications requiring a persistent connection between the browser and the server and is often used for real-time applications such as chat, news feeds, and web push notifications.

**Technology Stack for Database**

**Cloud Firestore** is a repository of NoSQL documents designed for automatic scaling, high performance, and ease of application development.

**Technology Stack for File Management**

**GitHub** is a system used to store a project's source code and record any modifications to that code in its entire history. It allows developers to work more efficiently on a project by providing resources from different developers to manage potentially conflicting changes.

## Software Specification

The section describes the functional requirements used in the study. It includes the programming language, platform for development, and management of the database.

The mobile development uses Android Studio IDE with Java being the back end programming language, and XML for front end builds. The application can run in any android device with Android 5.0 Lollipop version and higher.

The website or web app development involves the use of Node Js for backend support. For the frontend, React js is the primary framework to create the components with Bootstrap providing design beatification. HTML, CSS, and Javascript are additional languages to use when necessitated. Sublime IDE is the preferred environment used to code the web app. However, collaborators may use other applications suitable for the purpose.

Cloud Firestore is the database of choice to support the project. Both mobile and web application connects to Firestore for all data. GitHub supports the collaboration of the members and allows them to code concurrently for more efficient and time-conscious development.

## Program Specifications

Program specifications contain the list of algorithms needed for the system.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Programmer/s** | **Modules** | **Learning Center** | **Educator** | **Parent or Student** |
|  | **Account Management** |
| 1. Registration | \* | \* | \* |
| 2. Authentication | \* | \* | \* |
| 3. Login | \* | \* | \* |
| 4. Profiling | \* | \* |  |
| No. of Points *(1 point per module per user)* | | 1 | 1 | 1 |
|  | **Hiring Module** |  | | |
| 1. Hiring Profile/Resume |  | \* |  |
| 2. Job Searching |  | \* |  |
| 3. Job Posting | \* |  |  |
| 4. Job Suggestion |  | \* |  |
| 5. Hire Suggestion | \* |  |  |
| 6. Hiring | \* |  |  |
| No. of Points *(1 point per module per user)* | | 1 | 1 | 0 |
|  | **Enrollment Module** |  | | |
| 1. Input/Add Course Details | \* |  |  |
| 2. Search/Display Course List | \* | \* | \* |
| 3. Course Selection |  |  | \* |
| 4. Fee Calculation |  |  | \* |
| 5. Enrolment Details and Processes |  |  | \* |
| 6. Payment Scheme Selection |  |  | \* |
| 7. Payment |  |  | \* |
| 8. Record Payment | \* |  | \* |
| No. of Points *(1 point per module per user)* | | 1 | 1 | 1 |
|  | **Scheduling Module** |  | | |
| 1. Input Class Details | \* |  |  |
| 2. Update Class Details | \* |  |  |
| 3. Input Schedules | \* |  |  |
| 4. Schedule Request |  | \* | \* |
| 5. Update Schedules | \* |  |  |
| 6. Generate Calendar of Activities | \* | \* | \* |
| 7. Notification of Changes | \* | \* | \* |
| No. of Points *(1 point per module per user)* | | 1 | 1 | 1 |
|  | **Teaching Assistance Module** |  | | |
| 1. Retrieve Class Details |  | \* |  |
| 2. Suggest Daily Lesson Plan |  | \* |  |
| 3. Keep Student Records |  | \* |  |
| 4. Track Student Progress |  | \* |  |
| No. of Points *(1 point per module per user)* | | 0 | 1 | 0 |
| Number of Modules per User *(equals total no. of points per user)* | | 4 | 5 | 3 |
| Total Number of Modules | | 12 | | |