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Sur le thème

A Crowdsourcing Mobile Application and Interactive Learning Analytics Dashboard to enhance Project-Based Learning supported by technology. Case study of Multi-Role Project (MRP) method at the University of Tiaret

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We dedicate our graduation to all of the Resources

that enabled us to succeed.

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Abstract

The subject of this thesis falls within the framework of scientific research related to the principles and educational methods to improve learning in higher education. This work focuses on the Multi-Role Project (MRP): a new method of Project-Based Learning (PjBL) for Science, Technology, Engineering, and Mathematics (STEM) education. The study aimed to evaluate the MRP method on 2 aspects: (1) the degree of motivation of the students to use this method in the context of the Algerian University, in particular that of the Ibn Khaldoun University of Tiaret, knowing that MRP was developed as a PjBL method in a European context which differs significantly from the Algerian context, and (2) its fifth principle which includes communication, collaboration and content management. Regarding the first aspect, we evaluated MRP using Rolland Viau's theory, which allowed us to see that MRP lacked motivation, an essential asset for its application in such a context and that MRP should take it into account. Knowing that IT support for the successful implementation of MRP is vital, we found that the current generation is increasingly using mobile phones, which directed our study towards MRP in a mobile software environment. On this basis we refactored MRP to adapt it to our context and named it MRP2.0. In response to the second aspect, we proposed Stud-E, an MRP2.0-based learning approach enhanced by Crowdsourcing for Education (CfE). Stud-E is an incentive for students to create content that helps them establish an impressive profile in their identity as a future project. Stud-E provides students with areas of knowledge related to 21st century skills, interactions, and personalities in Stud-E builds a higher education social network. Finally, we designed a distributed system architecture in such a way as to solve the large data structure problems. We have also built four software that basically communicate with each other. We mention them as follows: 1) Server-side software, 2) Student-side software, 3) Administrator-side software and 4) Supervisor-side software.

Keywords— Project-based learning, Multi role project, Crowdsourcing for education, Higher education, Motivation, E-Learning, Distributed system, Intelligent system.

ملخص

في رسالتنا هذه ركزنا على قطاع التعليم العالي و البحث العلمي، بحيث احتوى عملنا اولا على مراجعة الادبيات المتعلقة بتقنية التعلم بواسطة المشاريع، ثم تطرقنا الى (MRP) (مشروع متعدد الادوار)، وهوومنهج جديد من نهوج التعلم القائم على المشاريع، يختص بالمجالات العلمية: العلوم، التكنولوجيا، الهندسة، والرياضيات او ما يعرف بإختصار (STEM) ، اذ قمنا بتقييمه من جانبين: ١) مدى تحفيز الطلاب على استخدام (MRP) كمنهج في الجامعة الجزائرية خصوصا جامعة ابن خلدون بتيارت. مع العلم انه تم تطويرها في سياق اوربي يختلف كثيرا عن السياق الجزائري. ٢) المبدأ الخامس الذي يتضمن التواصل ،التعاون وإدارة المحتوى. فيما يتعلق بالجانب الاول، قمنا بتقييم (MRP) بإستخدام نظرية (Rolland Viau's) التي اظهرت ان (MRP) تفتقر الى عامل التحفيز، والذي يعتبر عاملا أساسيا لتطبيقها في السياق الجزائري، أيضا دعم التكنولجيا IT (Support لها يعتبر عاملا أساسيا لتنفيذها بشكل صحيح. وجدنا أن الجيل يستعمل الهواتف الذكية بشكل متزايد، لذلك توجهة دراستنا الى تنفيذ منهج (MRP) في بيئة برامج هواتف، على هذا الاساس قمنا بهيكلة (يغع) لتكييفها مع سياقنا و سميناها (MRP2.0) استجابة للجانب الثاني. و من أجل تنفيذ المبدأ الخامس ل MRP2.0 لاحظنا أنه يفتقرللتفاعلات، وكنتيجة لذلك نقدم نهج Stud-E ، وهو نهج تعليمي قائم على اسس MRP2.0 مدعوم بالتعهيد الجماعي للتعليم. الى جانب منهج MRP2.0 اذ يعد Stud-E حافز يدفع الطلاب لإنشاء محتوى يساعدهم على تكوين سيرة ذاتية احترافية تخدمهم مستقبلا في مسيرتهم المهنية، ويوفر لهم مجالات من المعرفة العلمية المرتبطة بالقرن الحادي والعشرون. يمكن أيضا أن نصف Stud-E انه شبكة اجتماعية تجمع العديد من الجامعات فيما بينها لتحقيق ما يعرف بالتعهيد الجماعي للتعليم. أخيرًا ، قمنا بتطوير هياكل الأنظمة الموزعة بطريقة تحل مشكلات بنية البيانات الضخمة. كتطبيقات ل Stud-E قمنا بتطوير أربعة تطبيقات تتواصل بشكل أساسي مع بعضها البعض ، نذكرها على النحو التالي: ١) برنامج من جانب الخادم ٢) تطبيق للجوال للطالب ٣) موقع للمشرف ٤) ويب سريع الاستجابة اللاساتذة والجهات الاخرى.

الكلمات المفتاحية: التعلم القائم على المشروعات ، المشروع متعدد الأدوار ، التعهيد الجماعي للتعليم ، التعليم العالي ، تحفيز، التعلم الإلكتروني ، النظام الموزع ، النظام الذكي.

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0 | General Introduction

0.1 Introduction

Knowledge of different learning styles has become essential to presenting information in an appealing way to students. By understanding their student's individual learning preferences and formats, supervisors can make course information more accessible and help students feel more confident in the classroom.

The effectiveness of different learning styles, namely, active and passive, has been discussed a lot within universities. But what do the terms "active learning" and "passive learning" really mean? How do these two learning methods affect a student's motivation?

According to Johnson and Johnson (2008), In universities all throughout the world, there is a focus on active learning. Studies have shown that having students participate in cooperative learning leads to better success, more retention, motivation, more favorable attitudes by the students towards one other and the subject matter, and stronger academic self-esteem, compared to passive learning. When we said cooperative groups Project-Based Learning (PjBL) shine, thus PjBL is an active learning method that places students at the center of the learning process, with the instructor playing a supportive role. One of the reasons why PjBL is mentioned as a major approach since there are hundreds of studies going back to the late 1800's. Formally presented to schools by the philosopher and educator John Dewey (1859-1952), it was the work of Kilpatrick as we will mention in chapter 1.

In recent years, PjBL has increasingly been assisted by computer technology and has helped to promote the student-directed scientific investigation of challenges in real-world situations. When incorporating technology into learning, students are more likely to build on what they learn through technical abilities and experiences when their previous knowledge is recognized and made important to the learning process. From this viewpoint, integrating technology-focused knowledge creation to students' needs and interest rather than just giving technical training separated from the curricular or instructional goals need to be stressed (ChanLin, 2008).

Among the recommended methods, Multi Role Project (MRP) which is a generally applicable project-based learning method, and outlines its implementation and assessment in the context of a Science, Technology, Engineering, and Mathematics (STEM) course. MRP method is constructed around a meta-principle that perceives the project learning activity as a role-playing game. The results of its application to student projects show that MRP method was solidly implemented by the students, who learned to coordinate their activities in order to build communication and gained technical knowledge and non-technical abilities to a highly satisfying level.

However, the available literature demonstrates that the supervisors found PjBL very useful to use in their instruction such that it promotes students or teachers learning and motivation, collaboration and a sense of community at school level, student-centered learning, and brings versatility for their instruction. However, the most challenging aspects of PjBL implementation in reality were: project structure, technical concerns, resources, student-related obstacles and teamwork. Instructors pedagogical content knowledge in PjBL should be developed for better application of PjBL in practise via collaborative learning in which students, supervisors and other participants are learning from each other (Aksela and Haatainen, 2019). Some issues have been alleviated with the advent of MRP method, but there are still challenges, the most apparent of which is that MRP is a heavy-handed method.

0.2 Research problem and motivation

Several earlier studies have explored the impact of learning styles on student engagement in behavioral, emotional, and cognitive issues for PjBL(Halif et al., 2020).

The purpose of PjBL is an educational strategy that has been demonstrated to be successful because it enables students to take an active role in their own learning process. By engaging in the project-based learning paradigm, students are able to construct their own knowledge and reflect on their own learning projects, resulting in greater motivation and self-efficacy (Shin, 2018). The latter are information systems, increasingly computerized and complicated, in which numerous players (Student, Supervisor, IT Support). These studies suggest that real, student-driven methods to PjBL increase student achievement. Nevertheless, the solutions proposed in these studies still have low coverage and are insufficient to address the main issues. We are interested in PjBL applied to higher education.

As we said at the beginning of this introduction, the selected subject comprises 3 phases:

1. The first phase is connected to literature research on project-based learning to MRP method, with IT assistance. The proposed effort comprises the definition, specification, and assessment, in advance, of MRP method being a broadly applicable PjBL approach. In PjBL where a group of representatives works on the implementation of two projects: an educational project and a productive project. The main actors are the students, but for their projects to be successful, they must work with (supervisor representatives) who play different roles: Business Expert, Client, Education Expert, etc. As part of this study, these roles are identified utilizing an educational method: MRP method.

2. The second phase is to undertake an MRP analysis to work on the Algerian context. The suggested study consists of an assessment of MRP method, while it is a method that solves all the drawbacks, it is a successful approach. However, MRP is a fairly heavy-handed method that aims to be student-friendly and motivational. We have worked to adapt on Algerian university, and we have done what is termed MRP refactoring, as a consequence of MRP2.0 which extends to MRP. MRP took on a new dimension the fifth role.

3. The third phase is the procedure connected to creating content for education. A new phrase will join the research context, crowdsourcing. Crowdsourcing is an enhancement of MRP2.0 method, therefore the research term of our result we called Stud-E. Stud-E extends to MRP2.0 Which is an extension of MRP method.

However, the literature available in the context of research requires assistive development factors affecting the world of higher education (in order to be a favorable environment for student growth), in particular, pedagogical skills by utilizing MRP method. All issues faced by MRP have been passed on to Stud-E, with significantly greater issues. Training platforms like LMS (Learning Management System) give little or no aid for instructors. Al-Handhali et al. (2020) have argued that learning management systems tend to be course-centred rather than student-centred. The availability of tools may be utilized as required by the requirement to re-skill instructors. Now, a Learning Management System (LMS) does not handle the complete spectrum of teaching approaches and does not give tools for particular pedagogical practices. Adapted tools made utilizing current platform technologies such as LMS Moodle and making use of plug-in technology might encourage students and supervisors to make extensive use of these and from there, one can expect for a greater pedagogical quality of instruction. As part of

our study subject connected to project-based education, our hypothesis is to design an integrated system that adapts to the two generations and overcomes all issues that we think will lead to a higher education quality of teaching.

0.3 Research Questions

This thesis intends to address the following Research Questions (RQ):

- **RQ1 (Acceptability):** This question is part of a global context addressing student behavior and motivation that arose with the use of PjBL in other words the use of MRP method in perspective of the value to which the student is motivated and considers his requirements and skills that he would obtain. It is divided into 4 sub-questions:

  1. To what degree are students enthusiastic on adopting MRP method? Is it motivating to be an approach to learning, particularly at the Algerian Universities (Ibn khaldoun University)?
  2. What are critical student needs for applying MRP method?
  3. Is extrinsic motivation a good notion to assist apply MRP method?
  4. Will Crowdsourcing be supportive of MRP method and more motivating for Ibn khaldoun University students?

- **RQ2 (Effectiveness):** MRP is a new method of PjBL with the assistance of technology, and at the same time, it is a heavy-handed one. The conditions fluctuate from one university to another, owing to the fact that the students of Ibn khaldoun University need help to apply them. Crowdsourcing is the one appropriate, Crowdsourcing is the act of gathering services, ideas or material via the participation of a large group of individuals. this RQ is divided into 2 sub-questions:

  1. How effective is crowdsourcing to assist MRP, as we know MRP is a successful yet at the same time heavy-handed method, will crowdsourcing address MRP issues?
  2. How effective is each process of the proposed crowdsourcing approach?

- **RQ3 (Benefits):** The crowdsourcing approach has unexpected solutions to difficult situations. The approach may benefit MRP method for students, supervisors, and other parties

that will take MRP to another level. this RQ is divided into 2 sub-questions:

1. Does the crowdsourcing approach benefit MRP method for both students and supervisors? If so, is there a specific context in which a group outsourcing approach would be particularly useful to students and supervisors?

2. To what extent does our approach meet the needs of different student groups, supervisors, and external parties?

- **RQ4 (Satisfaction):** MRP method is a method assisted by technology. Several proposals were given, but the fact that crowdsourcing will be provided to assist MRP, we are in the middle of a big challenge since crowdsourcing may be presented in another word, which is social networks. this RQ is divided into 2 sub-questions:

  1. To what extent will are supervisors and students satisfied and keen to use the proposed crowdsourcing approach to enhance MRP method?

  2. To what extent will supervisors and students be pleased with the usage of the new system that should be friendly to them and be realisable for the new approach?

0.4 Research Aims and Objectifs

This thesis Aims(A) to present a novel approach which is crowdsourcing for education to enhance MRP2.0 to solve throughly the issues indicated in section 1.1. The approach has been reviewed in terms of efficacy, advantages, problems, and overall satisfaction, as well as drawing similarities with the present state of the art. The suggested approach is largely focused on 5 basic aspects:

- **A1:** Testing MRP method from several aspects, the motivation side, and the implementation side within the scope of implementation on the Algerian university.

- **A2:** Investigating for an expanded approach to MRP that is technically practical and designed for the current generation.

- **A3:** Improving learning by utilizing a MRP method as exciting, and seeking to develop a connection between the academic side and the businesses side.

- **A4:** Improving communication and collaboration among students among themselves,

students, and supervisors.

- **A5:** Provides an insight into the new system IT support for MRP refactoring enhanced by crowdsourcing for education.

To accomplish the above aims, the following objectives(OBJ) need to be fulfilled:

- **OBJ1:** Review of the literature related to PjbL down to MRP method in relation to the student behavior and motivation issues.
- **OBJ2:** Identify the main criteria and needs that must be included in the proposed MRP2.0 which is an extend of MRP.
- **OBJ3:** Investigate the inclusion of a motivational component, which will be the connection between the businesses and the universities.
- **OBJ4:** Suggesting a new tool for MRP2.0 method that provides the best experience for the two generations Y and Z.
- **OBJ5:** Proposing crowdsourcing as a way to enhance MRP2.0 in new challenges would necessitate a two-fold expansion of MRP.
- **OBJ6:** Evaluate the benefits, satisfaction, and effectiveness of the new approach in resolving the student motivation concerns in diverse scenarios of students and supervisors.
- **OBJ7:** Design and implementation of a new approach to crowdsourcing for education to enhance MRP2.0 method.
- **OBJ8:** When it comes to crowdsourcing, we are challenged to build a social network for a novel method. The objective is to solve this challenge.
- **OBJ9:** Summarise the outcomes of this thesis and offer suggestions and guidelines to aid future researchers interested in creating effective MRP and crowdsourced-based solutions.
- **OBJ10:** Will create a user guide containing all app use details and responsive web for Stud-E.

0.5 Research methodology

Our research methodology is applied research aimed at acquiring new knowledge. It is directed towards a practical and determined objective which consists in setting up a crowdsourcing mobile application and learning analytics dashboard to enhance Project-Based Learning (PjBL) supported by technology. The case study is related to the application of the MRP method in the context of the Algerian university, particularly Ibn Khaldoun University of Tiaret. Knowing that MRP is inspired by the PjBL method in which students learn by actively engaging in real-world and personally meaningful projects, we conducted a literature review by collecting and analyzing numerous articles and scientific content, which allowed us to obtain a state-of-the-art view of scientific progress in PjBL in higher education. This part of the research allowed us to acquire new knowledge that will be very useful to us in the rest of our research.

Next, we moved on to evaluating MRP and examining the technology tools students use in their learning. The evaluation of MRP in the context of the Ibn Khaldun University of Tiaret led us to identify the gaps that could hinder its application. We used Viau's theory which allowed us to find that MRP is lacking on the stimulus aspect, namely Motivation. Also, improving interaction and communication will encourage students to adhere to this new way of learning. Regarding the technology tools students use in their learning, we have noticed that this generation of students far prefers the use of smartphones over desktop applications. To do this, we refactored MRP to adapt it to our context and called it MRP2.0. and we proposed Stud-E, an MRP2.0-based learning approach enhanced by Crowdsourcing for Education (CfE).

Once we completed this part of the research, we touched on the engineering of the Stud-E system. We designed a distributed system architecture in such a way as to solve large data structure problems. To get the most out of Stud-E, we have also built four software that basically communicates with each other dedicated to each stakeholder (Student, Supervisor, Database administrator, System administrator).

0.6 Thesis structure

The structure of this thesis consists of 6 chapters. The details of each chapter are described below:

- **Chapter 1 (Literature Review).** provides a review of the relevant literature work with the aim of highlighting the PjBL, concentrating mainly on MRP method. In addition, we offer an overview of MRP method and then show a full application of the previously presented MRP method in connection to STEM education and proceed to analyze the above-mentioned methodology.
- **Chapter 2 (Refactoring MRP).** in this chapter, we offer the purpose of identifying existing issues associated with MRP. We shall define that MRP must be ready in application at Ibn Khaldun University level. We will strive to examine each generation to create an appropriate tool, after which we will uncover real-world concerns that drive students to apply a socio-cognitive model of students' motivational dynamics. As a consequence of this chapter we will provide MRP2.0 which the expanded of MRP.
- **Chapter 3 (Crowdsourcing to enhance MRP2.0).** introduce a new approach Stud-E is an extension of MRP 2.0 enhanced by crowdsourcing for education, before we propose a new approach we provided accompanying literature to support the mass outsourcing of PjBL and collective intelligence, accessible in global efforts and social networks that freely reflect solutions and trends. Social networks are founded on free and high-visibility contributions as other possibilities for gathering and integrating information all around the globe. The chapter also concentrates on providing A Design Scenario supported by An Analysis of Stud-E.
- **Chapter 4 (System Design).** discusses the System Design of the proposed Stud-E as High-level then presents the Low-level System Design. It starts with an explanation of the High-level. Followed by Low-level System Design of each component with its needs data base Design, Security, and Learning Analytics Dashboard. Finally, this chapter will introduce a new challenge that will lead us to Chapter 5.
- **Chapter 5 (Distributed System).** discusses the distributed system, which is a solution to what was addressed in the previous chapter, that the system is learning management with a social network. The system is confronting a difficulty, which is big data. as a solution,

we suggested distributed system as a big data structure.

- **Chapter 6 (Implementation and Deployment).** describes the implementation and deployment of the proposed Stud-E approach in detail: tools, software technologies, algorithms, servers cost...etc.
- **Chapter 7 (conclusion and Future Work.)** describes an overall overview of the thesis. A short assessment of the conclusions reached from the study is offered, as well as the significance of these discoveries to the area. Furthermore, the chapter also presents a list of key guidelines and suggestions to aid other practitioners and scholars in the sector. The chapter then finishes by detailing the study limitations and suggested areas for future work to build on this research.
- **Appendix A (UX case study and Student guide.)** In the appendix we share further information regarding UX Research. A guide has also been produced for the Student on how Mobile Application work.

Part I

State of the art

1 | Literature Review

1.1 Introduction

Learning needs to adapt to new student profiles by taking into account that students' interaction with traditional forms of teaching, based on lectures and seminars, has diminished significantly. In fact, learning is viewed as a collaborative effort that involves providing students with conditions, expectations, and opportunities to participate(Umar and Ko, 2022). This is why active learning is highlighted. Active learning involves providing opportunities for students to speak, listen, write, read, and think about content, ideas, issues, and interests related to an academic topic because it increases students' sense of progress and control over their learning (Zayapragassarazan and Kumar, 2012). Active learning is a broad concept that comes in many forms **Example.** Problem-Based Learning, Project-Based Learning, Challenge-Based Learning and Game-Based Learning. etc (Dominguez et al., 2019). Among all the forms above, in our thesis, we will touch on the study and implementation of Project-Based Learning (PjBL). If we are serious about reaching 21st Century educational goals, PjBL must be at the center of each student's cursus. PjBL is a method that is widely applicable; it discusses its implementation and assessment in the context of (STEM). To solve this issue, a PjBL known as the Multi-Role Project (MRP) learning method was developed by (Warin et al., 2015).

1.2 Project Based Learning

1.2.1 Introduction

Projects[1] are really making the world around. You may find an interdisciplinary team working together to make practically any project happen, whether it's creating a system, conducting a trial, or organizing an art display.

[1] you may be wondering how they can build the world when so many projects fail. We are talking about projects that have been successful. It goes without saying that failed projects lead to successful projects.

Students get a better understanding of the principles and standards at the heart of a project. Projects can assist in the development of crucial professional skills as well as lifelong learning habits. Projects can allow students to address community issues, explore careers, interact with adult mentors, and present their work to audiences outside of the classroom. Project-Based Learning (PjBL) promotes motivation.

While doing some project work in traditional classroom settings, various obstacles exist, such as increased time demands placed on students outside of class hours to interact with classmates and engage in project work. Students' contacts are frequently constrained in face-to-face settings, despite the fact that active engagement among group members is a critical aspect of effective project work. As a result, many academics focus on the use of technology while implementing PjBL (Heo et al., 2010).

In this section, We will cover all aspects of PjBL, from (1) history to (2) definitions to (3) the basic principle of PjBL, and then (1) present a result in our computer science department.

1.2.2 PjBL history

The instructors in the United States discuss the beginnings of Project-Based Learning, the name John Dewey frequently comes up (Dewey, 2013). which defined the notion of "*learning by doing*". Dewey's 1897 publication of "My Pedagogical Creed" marked the start of history of PjBL. All of that said, "learning by doing" is an idea that dates back to Aristotle [2] although before, and the concept of learning through "doing" is vital and instinctual in humans.

PjBL also represents a Vygotskian perspective. According to Vygotsky, a Russian cognitive psychologist, learning happens through social contact, which motivates individuals to deal with cognitive problems that are just slightly above their existing levels of competence (Wertsch, 1986).

1.2.3 Definitions of PjBL

Several authors have approached the PjBL from different angles and have given definitions(Blumenfeld et al., 1991; Stefanou et al., 2013; Bell, 2010).

[2] Aristotle was a Greek philosopher and polymath during the Classical period in Ancient Greece.

According to Blumenfeld et al. (1991), the definition of project-based learning is that a question or problem helps to organize and motivate activities, culminating in a final output that solves the "driving question." PjBL approaches frequently begin with a "driving question," where the task has authenticity because it is based on real-world problems (Stefanou et al., 2013).

PjBL is a student-centered approach to learning that is founded on three constructivist principles: learning is context-specific, learners participate actively in the learning process, and they attain their goals via social interactions and the sharing of information and understanding. It is a subset of inquiry-based learning in which the context for learning is given by realistic questions and challenges within real-world activities that lead to meaningful learning experiences.

According to Bell (2010) PjBL is a student-driven, teacher-facilitated learning approach. An inquiry is the starting point for each endeavor. Students create a question and are directed through the research process by the teacher. Even by their own nature, most projects combine reading, writing, and mathematics. Many of the queries are scientific in nature or stem from contemporary societal issues. A greater grasp of a topic, deeper learning, higher-level reading, and improved drive to study are all outcomes of PjBL. PjBL is an important method for developing autonomous learners and thinkers.

1.2.4 The basic principle of PjBL

PjBL involves students in an extensive process of inquiry in answer to a complicated issue, problem, or challenge. While some student "voice and choice" is allowed, rigorous projects are carefully planned, managed, and assessed to help students learn key academic content, practice 21st Century Skills (such as collaboration, communication, and critical thinking), and create high-quality, authentic products and presentations.

Figure 1.1 displays the essential relationships between the project-based learning concepts and the seven critical components of successful projects.

According to Larmer and Mergendoller (2010) PjBL is built on seven principles:

(a) **A Need to Know**, PjBL reverses the typical sequence in which knowledge and concepts are given. A typical lesson with a "project" add-on begins by presenting students with information and ideas and then offering them the option to apply them after they have

learned them. The vision of an end product or presentation is the starting point for PjBL. This provides a context and rationale for learning and comprehending the information and concepts.

(b) **A Driving Question**, A Driving Question is based on a free-form Driving Question By framing pertinent ideas, arguments, issues, or problems, students' work is concentrated and their learning is enhanced.

(c) **Student Voice and Choice**, This principle of project-based learning is critical. The more voice and choice students have in a project, the more significant it will feel to them. Supervisors, on the other hand, should develop projects with a high degree of students choice that are appropriate for their particular style and students.

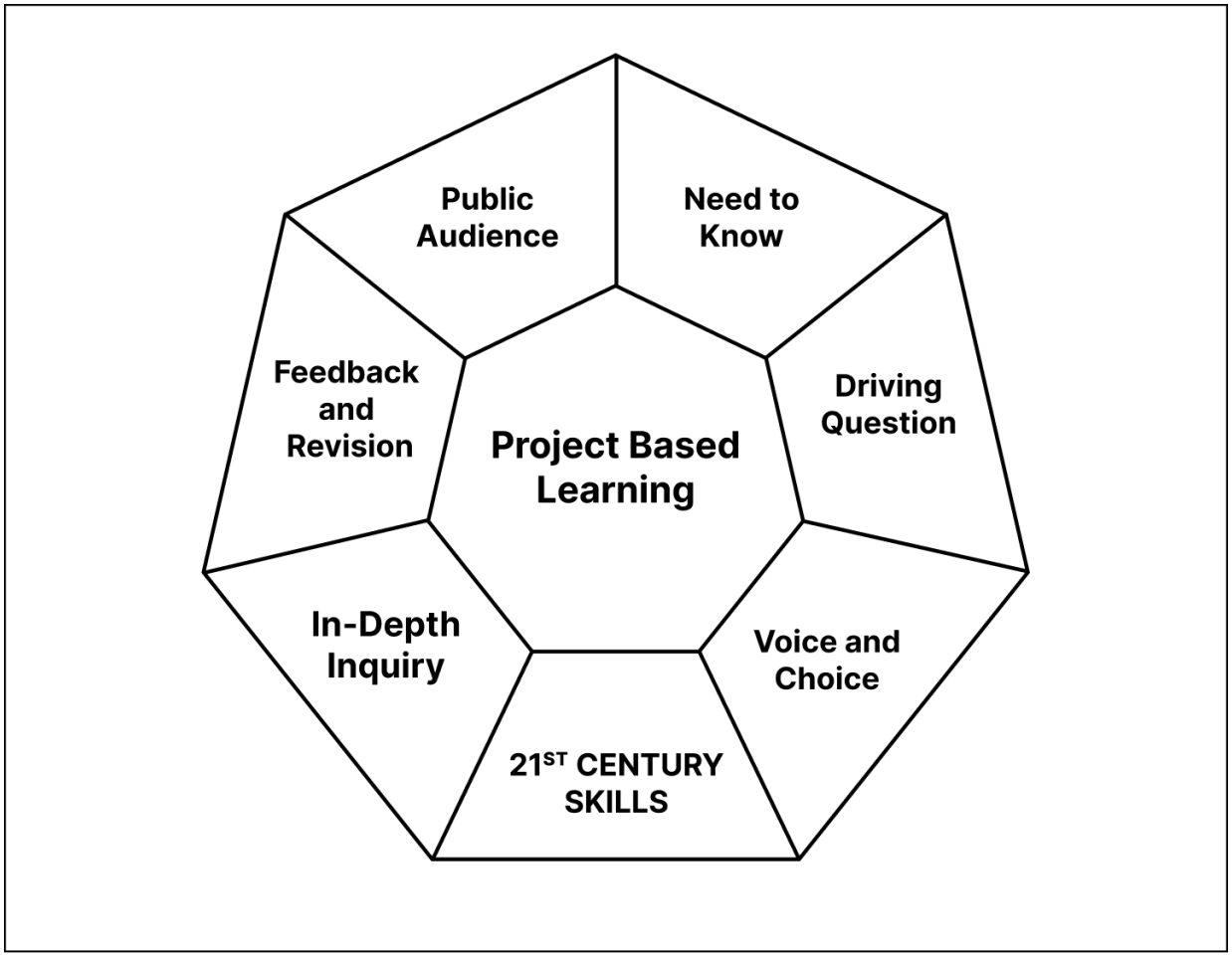

Figure 1.1: Principles of Project-Based Learning

(d) **21st Century Skills**, This principle allows students to develop 21st-century skills such as collaboration, communication, critical thinking, and technology usage, which will serve them well in the job and in life. This exposure to actual abilities satisfies the second

condition for meaningful work a significant goal. In a PjBL setting, a teacher explicitly teaches and assesses these abilities, and students are given numerous chances to understand themselves.

(e) **In-Depth Inquiry**, Deep inquiry as part of the learning and creation process Students ask questions, seek answers, and make conclusions, which leads them to create something new: an idea, an interpretation, or a product.

(f) **FeedBack and Revision**, Students learn to provide and accept feedback in order to enhance the quality of their work, and they are encouraged to reflect on what and how they are learning.

(g) **Public Audience**, Students present their work to others except for their classmates and supervisors, either in person or online. This "raises the stakes," enhancing students' drive to produce high-quality work and adding to the project's authenticity.

PjBL must be at the core of 21st Century instruction in order to achieve 21st Century educational goals[3]. Unlike the short "project" or activity introduced in typical training, the project contains and frames the curriculum.

1.2.5 Synthesis

For the last year at Ibn khaldoun University, we've implemented PjBL as the central feature in a mini-project in our Advance Data-Base and Data-Mining(BDADM) class to enhance learning for the First year master's in software engineering. Students are involved in the design of this program through classroom projects. Individual professional abilities are developed by first-year students by creating and implementing first-semester projects with an emphasis on advanced algorithms and complexity, multi-Agent systems, and database management systems. The core creates and executes a semester-long project that incorporates topics from the project emphasis area they select at the start of the year. Our supervisor, assigned us a project titled Hafezni in BDADM course at the start of the semester. Before we started working as a team, it was nearly difficult to comprehend the fundamentals of what we were going to learn. Since the PBL application, we have noticed significant changes in our Team. Our Supervisor notes that Students are critical and independent thinkers and more prepared for professional work-

[3]Educational goals are statements that describe the skills, competencies, and qualities that you should possess upon completion of a course or program

specifically, This was after we had presented our project and had a firm grasp of the BDADM. in terms of adaptability - than our peers from other students who did not work the project and we also noticed a huge failure for them. We attribute this to the context of the cooperative learning experience. Our surveys indicate a high level of student satisfaction and effectiveness as well. For example, for the last year that ended, 15 students reported positive attitudes toward PjBL, while only two reported a negative attitude (33 students remained neutral); Similarly, students indicated that project-based learning is pedagogically beneficial For seeing our success in class.

1.2.6 Conclusion

Researchers revealed a decade ago that PjBL students are more engaged and motivated. PjBL enables students to develop critical and independent thinking skills, resulting in pupils taking responsibility for their own learning. Students' capacity to apply, convey, and retain knowledge improves when they take responsibility for their own learning. As a result, PjBL improves student academic achievement.

1.3 Multi Role Project

1.3.1 Introduction

The Multi-Roles Project (MRP) is a project-based learning method created at the University of Littoral, Cote d'Opale, France in 1999. It establishes the fundamentals of a systematic and complete training strategy for the creation of tutored projects. MRP describe the tasks and behaviors that each actor must undertake. It also gives a conceptually and practical tools to help these approaches move forward (Talbi, 2017).

It is vital to have IT assistance in order to go forward and successfully apply MRP method.

In this section, we will describe MRP method, its implementation, and assessment using STEM. Following that, we will review previous IT support work and present a proposal for IT support for MRP method.

1.3.2 A description of MRP

According to Warin et al. (2015) MRP method began At the end of the 1990s A review of

student projects completed by more than 50 students in the second year of an undergraduate degree in computer science at the University of Littoral Cote d'Opale in France revealed the educational insufficiency of the project experience. Which becomes evident that a system was required to assit both Student and Supervisor, with an interactive and gradual approach was used to build this over the next 15 years. The method was created and then built to be a full and reusable solution for student project development. that means other people can adopt and use it in their own situations.

1.3.2.1 Meta principles

The meta-principle that MRP is built on is "carrying out a Student project is a role-playing game consisting of two projects performed by the Student team: a learning project and an engineering project." This meta-principle requires that a learning project and an engineering project be submitted prior to the commencement of the course, with supervisors assigned to one or more roles (Warin et al., 2015).

1.3.2.2 MRP projects

"*What we have to learn, we learn by doing*" said the Greek philosopher Aristotle. MRP requires you to work on two projects at the same time. You will work on a learning project and an engineering project throughout your time with Mrp. The engineering project's purpose is for the Student team to create a product for a client.

The learning project entails the student's acquisition of a set of knowledge previously relating to the skills of the 21st Century skills consisting of knowledge, real-world problem solving, skilled communication, collaboration, use of information and communication technology for learning, and self-regulation (Stehle and Peters-Burton, 2019). And as a result, students will be able to work in a team and learn new skills.

MRP based on role-playing includes a supervisor who plays different roles (Client, Expert, etc.), a student from a team to respond to client needs and develop new skills. MRP has identified four main roles: the Student and his team, MRP Expert, the Client, and the Tutor:

(a) **The Student's**, role is to work in a team, must improve his knowledge and skills, apply MRP and realize it according to the demands of the client.

(b) **The Tutor's**, role in helping the team to come together and respect MRP method also

helps the Student with the completion of their two projects and the tutor must help solve little conflicts and make students think about their behavior in the distribution of work.

(c) **The Client's**, role is to define and confirm the production project's demands, he is a person who has a global and premonitory vision of the product to be produced, the client must be able to answer the teams questions, what is needed â¦and must validate the project.

(d) **The Expert's**, role is responsibility is to answer the teams' issues. he is the most suitable person often outside projects that offer skills in relation to his field. Analyzes work and advises students.

The three actors, Tutors, a Client, and an Expert, all contribute to the evaluation and regular grading of the teams and students (Talbi, 2017).

We will now go over the fundamental path of Student work: A team should make an appointment with the supervisor if possible at least 48 h in advance. In the meeting, different roles are assigned to the Student, and quickly after the meeting, a professional report is drawn up and posted on the team project. it is accessible to all experts. The project also advances thanks to individual work and team meetings without a supervisory presence in order. In the learning project, we also find an estimate of the quantity of work that has to provide the deadline date of thesis defense.

1.3.2.3 Five principles

The method also establishes a conceptual framework that may be utilized to manage Student collaboration. This framework of five principles extends the meta-principle, namely: responsibility distribution, regular interactions and solicitations within the team, anticipation and continuous improvement, positive interdependence and alternating individual/collective work, and open communication and content management.

According Talbi (2017) these five principles are discussed more below.

1. **Description of MRP method**, The method's first principle is founded on the premise that there can be no successful collaborative effort without a division of tasks, MRP requires teams methodically defining and sharing responsibilities.

2. **Regular interactions and solicitations within the team**, The method's second principle is founded on the premise that regular contacts and requests from the team improve

project development. The notion of interaction pertains to the concept of communication and the seam of production. All contacts and requests have been documented, and the project control architecture is comprised of frequent team meetings.The principles for monitoring this is provided by regular team meetings see Figure 1.2

3. **Anticipation and continuous improvement (QualityWheel)**, The method's third principle is that seamless cooperation is dependent on anticipation, whereas quality is dependent on constant improvement. Anticipation and ongoing improvement apply to both educational and productive projects. Student must create timetables for both their educational and productive projects, as well as periodically check their progress and, if required, make corrective choices as a group.

4. **Positive interdependence and alternating individual/collective work**,The method's fourth principle is collective work should be arranged with a positive dependency between team members and should alternate individual work with a collective effort to compensate for collective work's relative slowness.

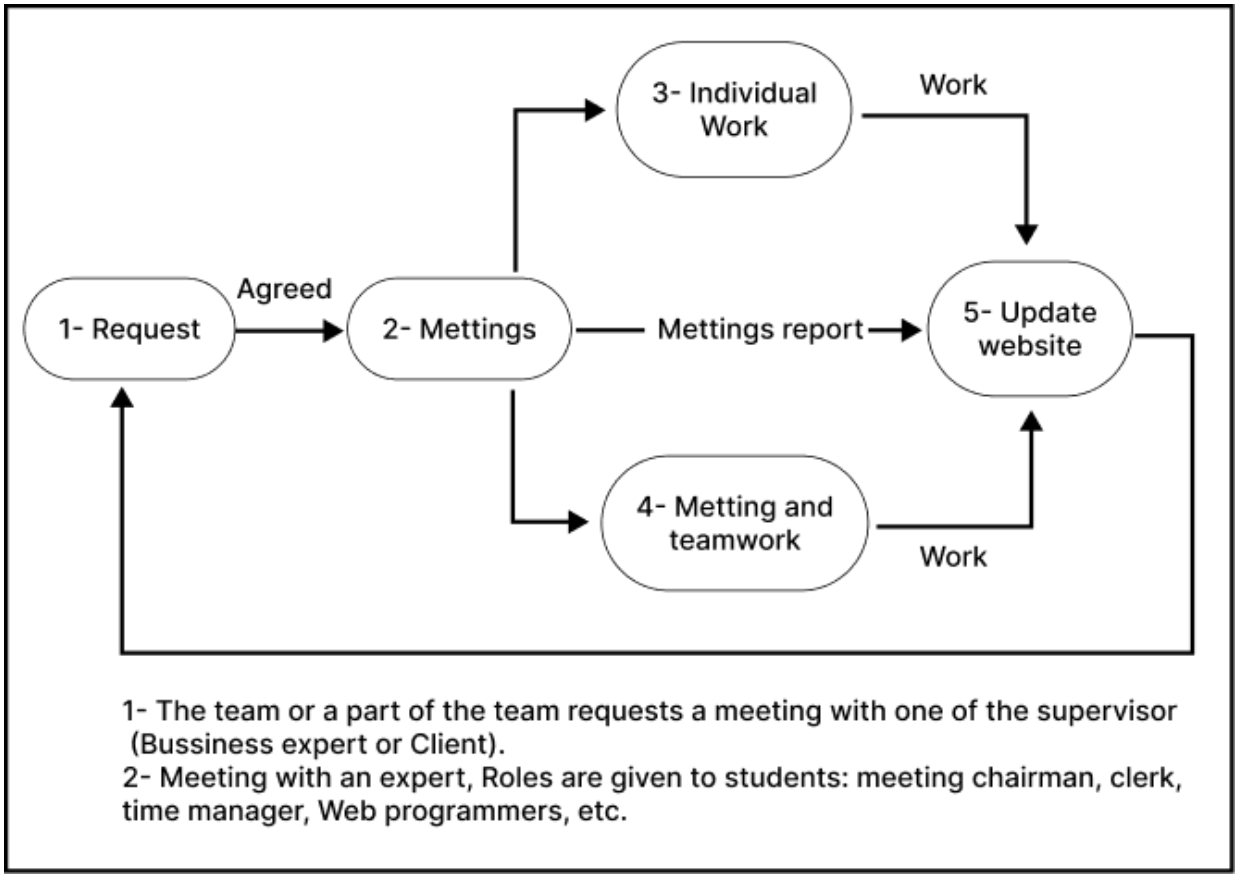

Figure 1.2: Basic cycle of Student work(Warin et al., 2015)

5. **Open communication and content management**,The method's fifth principle is that collective work must be built on open communication and content management. As a result,Warin et al. (2015) proposed that each project monitoring team create its own website. In practice, MRP involves specifying the following seven components at the project control site level: Home, Presentation, Members, Meetings, Collective deliverables, Individual deliverables, Links The home page describes the site and outlines the project. Presentation provides a more extensive overview of both projects. Members identify themselves, their strong points, areas for improvement, and their roles in the project on the Members page; they can also offer a curriculum vitae. All of the reports are linked from the Meetings page. The pages Collective deliverables and Individual deliverables include links to the different project deliverables. Each deliverable includes an appendix containing a version register that tracks its evolution and specifies the date, authors, and nature of the update. The team can contribute extra information and share relevant Web site connections on the Links page.

1.3.2.4 Global structure of MRP

The Figure 1.3 below depicts the meta-principal relationships, supervisory roles, the five principles that govern the Student team, Let's go through the Figure: The Student team is assigned two projects: one learning and one engineering. The learning project is as vital as the engineering project. There are several roles available: Student should form groups, a Tutor, and at least one Expert, a Client.

In addition, Student will conduct conventional research. They will therefore be led to study, not alone, to self-training, but with their team to discuss their challenges and progress, and with the experts in certain fields at their disposal to advise them, assist them in their learning, and validate their work.

Student play the most significant role since their primary purpose is to gain new information and skills. Particularly the five principles of successful teamwork. Student will need to master new information and abilities in order to complete their engineering project while according to the standards of their subject of study. Experts can provide instructional resources to assist them with these assignments.

During the first use of MRP method, 50 percent of the project time may be spent under-

standing, implementing the method, and managing the team. This is not wasted time; on the contrary, it allows him to improve his knowledge and skills in group work and project management. These two goals, collaborative work and project management, are critical components of the 'Project Student' exercise. Following that, the time spent implementing the method and managing the team is often less than 25% of the entire project time.

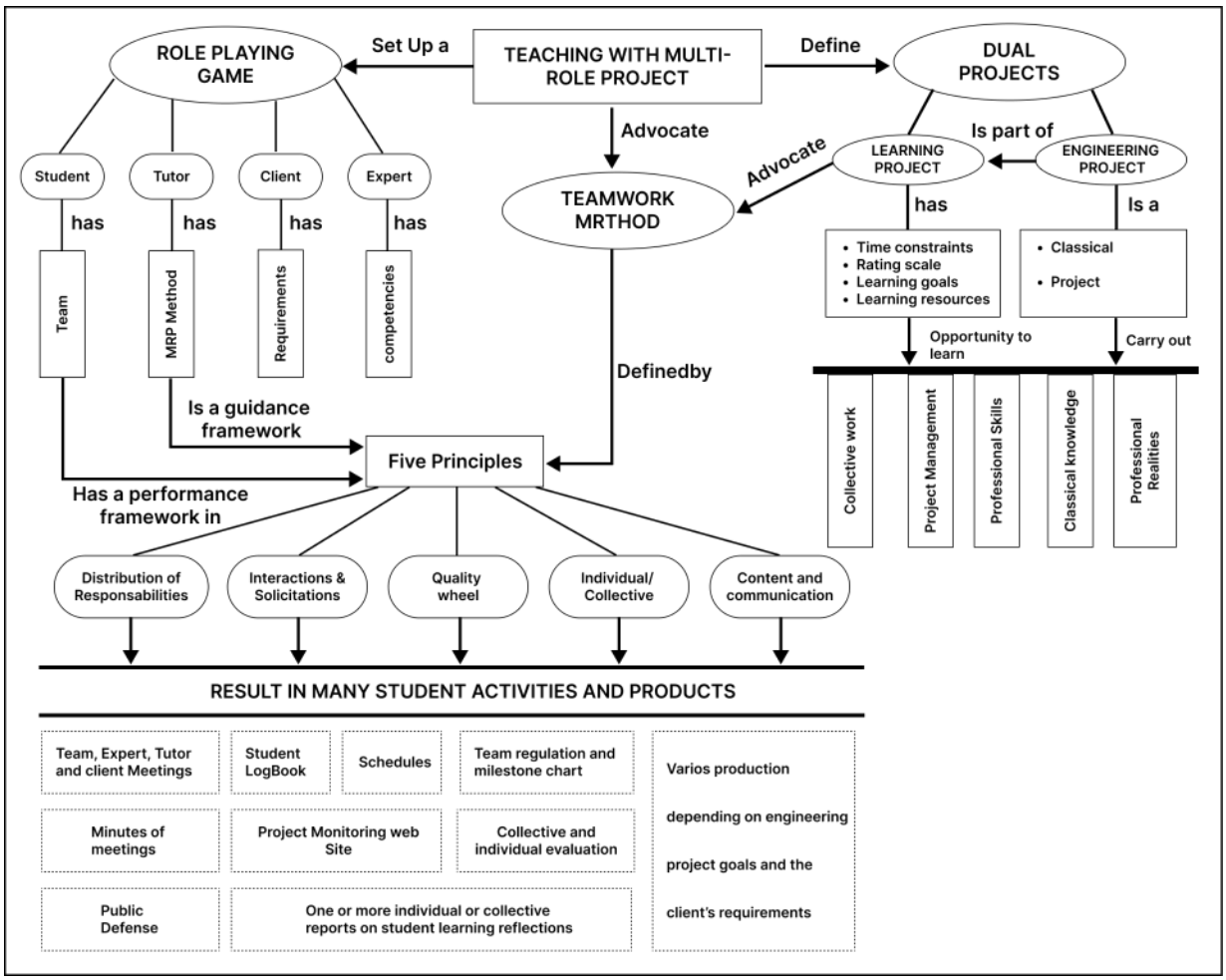

Figure 1.3: Global structure of MRP (Warin et al., 2015)

1.3.3 Application of MRP

According to Warin et al. (2015) MRP was used in a Master's-level Information System Project (ISP) course consisting of 12 4-hour teaching sessions, and was taught to 41 fourth-year students in the Master's degree program in Computer Engineering and Statistics at the graduate engineering school Polytech Lille, France in 2013,The students in the ISP studied MRP method. they were asked to produce a two-part (team and individual) learning report for each of the knowledge domains targeted by the project. At the end of the course, each team gave

a project defense presentation in front of their supervisors. They had to justify the choices and decisions made in their engineering project and analyze the ratio of collective and individual work for each team member. In the ISP course, The sixth MRP concept of open communication and content management was implemented using Moodle. Despite the fact that MRP has been shown to deliver a huge advantage, the authors believed that a control group in this study would be at a disadvantage.

1.3.3.1 Learning project

The learning project's major purpose was to comprehend MRP process and apply it to the ISP course. The teams were given two kits that outlined MRP method and the learning project, as well as access to a dozen prior year's projects. The learning project took up the majority of the first half of the ISP course. Student delivered learning deliverables using MRP method on a regular basis, either in groups or individually (Warin et al., 2015).

The educational advancement kit[4] also included educational objectives for the discipline of software engineering. It was about needs analysis, the "Two Tracks Unified Process" (2TUP) development technique, UML language, requirements specification, and software design in particular. In the instance of ISP, students were required to study and practice only the initial phases of the model, namely (1) functional requirements capture, (2) analysis, (3) technical requirements capture, (4) generic design, and (5) preliminary design, before moving on to () detailed design (Talbi, 2017).

1.3.3.2 Engineering project

According to Warin et al. (2015)The engineering project intended to create a software system to equip ski slope emergency posts. The first phase was for students to create an overall project timeline for the definition of this system. In the second phase, they had to start the implementation process, which included creating functional and technical requirements as well as general and detailed drawings. The rules required the usage of the 2TUP technique and the UML modeling language, both of which the students were unfamiliar with.

During each session, four experts were accessible to the Student teams: two engineers from industry and two instructors (lecturers). Each played one or more roles. Most of the exchanges

[4] http://mepulco.fr

between Expert and Student took place during session meetings. The Student were required to seek a meeting with the experts and submit a preliminary agenda. The agendas were reviewed by the experts, and after each meeting, a report was created and posted on the team's project tracking Web site.

1.3.3.3 MRP method utilizes IT support

IT support is required for MRP method to be implemented successfully. The participants working in an MRP-supported framework will need to adapt their understanding of MRP method on the one hand, and their usage of ICT on the other, Therefore, the fifth MRP principle must be implemented because the method would not work otherwise, for IT support for the application of MRP method is vital.

According to Talbi (2017) the fifth principle of MRP method has been completely implemented utilizing the Moodle platform, which is the platform most commonly used by University courses. Using Moodle to manage a project monitoring website allows Student teams, students, and supervisors to collaborate in a unified environment. the complete MRP process has been assimilated to space for communication and team content management, which is implemented by a Moodle. There, the Student team must construct their project monitoring website, which must include the elements specified by MRP method.

1.3.4 Synthesis

Finally, MRP is a reusable PjBL procedure.The results of its application to Student projects show that the method was solidly implemented by the students, who learned to coordinate their activities in order to build communication and gained technical knowledge and non-technical abilities to a highly satisfying level. It has also been discovered that MRP delivers learning objectives. Supervisors may also characterize the availability of assistance and technology for engagement, learning, and dedication, such that it is as close to an ultimate reality experience as feasible. Some students who work in businesses understand that MRP and career are two sides of the same coin.

1.4 Conclusion

In this chapter, we discussed project-based learning and its importance in inspiring students. We reviewed the curriculum, as well as some history and ideas. Then, through the IT Support Project, we transitioned to a new pedagogical method: MRP and its computer assistance. We shown that MRP method is a reusable project-based learning method. Student used the method actively in STEM education, learning to coordinate their work to form communication and improve technical knowledge and soft skills to a higher degree. They have given MRP method representatives with a Moodle addon that allows them to administer their MRP project monitoring sites in terms of MRP method computer assistance.

All studies show that it is an effective strategy, but how can we put it into practice; is the earlier work in the fifth principle still realizable in the actual context?; In the next chapter, we will take MRP to the next level by analyzing what MRP strategy needs; the generation who will utilize it? Particularly at massification universities.

2 | Refactoring MRP

2.1 Introduction

Previously, we presented an overview of MRP in chapter 1. We began with the history of PjBL to MRP, that the MRP method is a broadly applicable PjBL method, and we described MRP implementation in the context of STEM, its meta principle, a role-playing game, and five principles. In this chapter, we will refactor MRP. (1) We will discuss MRP needs, (2) we will propose a new tool for the MRP method, (3) we will present The New Dimension, and (4) we will propose a solution that will take MRP to the next level and will be implemented at Ibn Khaldoun University.

2.2 MRP Needs

Given the reviewing of the relevent literature in chapter 1 we were able to identify the appropriate methodology, including the methodological research phases, and the selected approaches of each phase which will help tackle the main research problem and answer the research questions as validly and accurately as possible. To form a practical and effective MRP method that satisfies the needs of Students and Supervisors that were not met by other PjbL approaches, emphasis was placed on engaging Students and Others in the development phases of the proposed solution. Thus, the User-Centered Design (UCD) (Abras et al., 2004) was adopted in this research as a basic approach that research methodology depends on, which will ideally contribute to the acceptance and success of the approach.

Our analysis of MRP processes and activities reveals several questions that we think can be a source of weakness in the workflow. These questions are:

- Reviewing the work of the relevant literature, MRP has IT support, which is required to successfully implement the MRP method. Several solutions have been proposed and implemented in the fifth MRP principle must be implemented since the approach would

not operate otherwise i.e one of the primary tools suggested by the authors for implementing the MRP method is the student team's creation of a project monitoring website, second Moodle Project Monitoring Website Plugin 4.3.6 of the MRP was developed by Talbi (2017), So, Is the previous research in the fifth principle, "Websites developed by students and Moodle plugin to ease works without the need to construct own websites only to get good experience," still realizable in the current context?

- There is no doubt that mobile apps have become an integral part of our daily routine. But what actually makes them better than mobile websites? According to the latest statistics[1], 90% of the time on mobile is spent on apps. Mobile apps have already taken the lead, and nothing has been proposed so far in terms of an MRP method especially combined with a dedicated Mobile app. So, will Mobile applications be a huge support to the MRP method, especially for generations Y and Z[2]

- PjBL is motivational for students to learn research methodology skills. It is a way to engage and give them ownership over their own learning. As the MRP is a broadly applicable PjBL method so it's motivational. MRP requires considerable knowledge, effort, persistence, and self-regulation on the part of the students. They need to devise plans and their approach. Tutor and Experts plays a critical role in helping students in the process by shaping opportunity for learning, guiding students, thinking, and helping them construct new understanding. So, Is the MRP method requiring extra motivation, and is it motivating to use?

- MRP is a successful method, according to its authors, yet with everything, it includes, MRP is a heavy-handed an method that strives to be friendly and motivating to the students. So, how can we put it into reality with a scaled-down version tailored to Ibn Khaldoun University?

The next section is dedicated to answering all questions, We will collect every two questions in a section and bringing MRP to the next level.

[1] https://rubygarage.org/blog/mobile-app-vs-mobile-website

[2] Generation Y "born between 1981 and 2001" and Generation Z "born after 2001" (Dimock, 2019)

2.3 A new proposed tool for MRP method

2.3.1 Introduction

The student team's creation and maintenance of a project monitoring website is one of the essential instruments for applying the MRP method. Provide supervisors and student teams with a Moodle plug-in that enables them to maintain their own MRP project monitoring webpages. Our effort aims to develop an integrated system, the most essential component of which is a mobile application for students and a responsive web for others. Why this proposal instead of the previous ones, while the latter allowed us to fully implement the fifth principle: "Open Communications and Content Management". So what are the reasons that prompted us to develop such a system?

2.3.2 Existing MRP IT support

According to Talbi (2017) to apply the fifth principle of the MRP method, each student team must maintain a project tracking website.To do this, They suggested several IT development methods, namely:

- Using activity modules from an LMS platform such as Moodle, in particular its Wiki activity modules.
- Using a content management system (CMS) such as WordPress[3], Joomla[4]..
- Add functionality to an existing platform.
- Develop a new platform (development from scratch). Right off the bat, we rule out the last possibility because it would be very time consuming and likely to waste our time reinventing the wheel.

In the case of our research, we are developing a new platform, not in fact reinventing the wheel but rather reshaping it, as did many before and many more after us will, that will focus on student and Mobile learning, According to Batmetan and Palilingan (2018) the majority of students 78% behavior to keep adopting mobile learning. Why? However, they reveal that the level of usability, ease of use, and ease of learning in various devices have a substantial influence

[3] https://fr.wordpress.org/
[4] (https://www.joomla.fr)

on the amount of mobile learning adoption the study's implications are that higher education students, particularly those of the Y generation, emphasize usability when it comes to mobile learning.

2.3.3 Mobile software technologies for generations

Every generation of students has unique features that reflect the circumstances of their time period. In order to build effective learning environments. In today's technology-driven era, students have different learning needs in comparison with their predecessors. To enhance learning in the new generation, it is recommended to use mobile app technology in class.

Mobile app technology plays a significant role in people's lives today, According to Zhang et al. (2017) The mobile app has become the key motivator of product and service innovation, allowing them to provide extra value. Mobile app technology enables easy access to new knowledge and encourages Generation Y customers to be social all the time, expanding social network systems beyond the Internet to mobile platforms. Generation Y, as digital natives, are inventive mobile enthusiasts who actively participate with social media in ways that set them apart from prior generations.

Representatives of the Z generation are distinguished from millennials by the fact that they were "born with a smartphone in their hands." Unlike Generation Y, they have grown up with digital technology, and the Internet is a vital part of their life. Poláková and Klímová (2019) found that using the mobile app in their experiments was more entertaining for Generation Z students than traditional teaching methods, and also contributed to cooperative learning.

According to DeIuliis and Saylor (2021), we can identify the"glow"[5] and "grow"[6] areas that the common feature between the two generations(Y,Z) is their compatibility with technology, specifically website and mobile app technology.

2.3.4 Overview of our propsed system

This section is devoted to presenting the contribution materials. First of all, we will present an overview of our system and its common functionality. Figure 2.1 provides an overview of our system and its main components:

[5]Glow is an alternative term for "strengths" or "positives" and indicates areas of achievement and success.
[6]Grow is an alternative term for "weaknesses" or "negatives" and indicates areas for constructive growth.

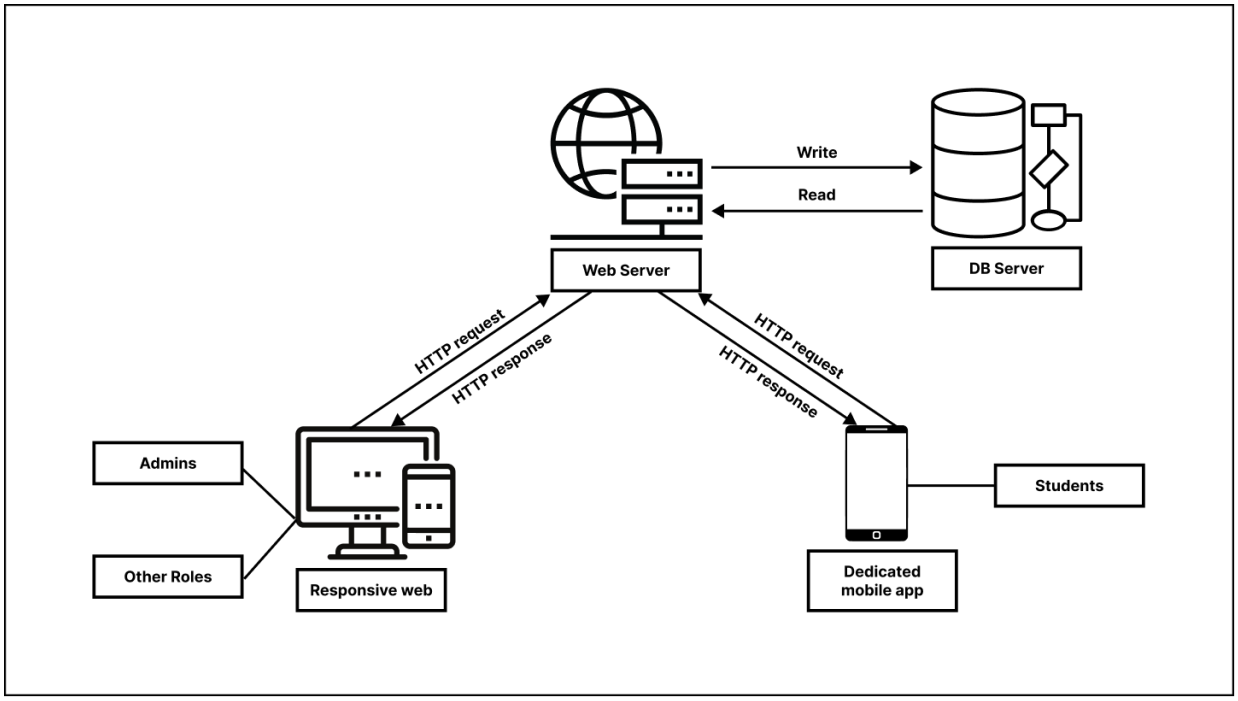

Figure 2.1: Overview of our propsed system design

1. The first component is our web server, which is software and hardware that responds to HTTP (Hypertext Transfer Protocol) requests from students and other people over the World Wide Web (Arlitt and Williamson, 1997). Our web server's primary function is to show website content and mobile app content, as well as process and transmit content to students and other roles.

2. The second component is Database server (DB server), DB server is used to store and manage databases that are stored on the server and to provide data access for authorized users. It also allows users and applications to centrally access the data across the network. In our system we used MySQL, MySQL is the most popular Open Source SQL database management system, and it completely satisfies the ACID[7] criteria for a transaction-safe RDBMS. MySQL is also created, distributed, and maintained by Oracle Corporation.

3. The third component is Responsive web, We were dissatisfied with a mobile application for our supervisors and other roles, since the they are older and requires a larger screen, However, while discussing responsive web, we emphasize the small screen. for a better experience

4. The forth component is Dedicated mobile application, As we mentioned in subsection 2.3.3

[7]In the context of transaction processing, the acronym ACID refers to the four key properties of a transaction: atomicity, consistency, isolation, and durability.

Generation Z are involved in mobile apps deeper than other generations. This is why we represent and use it. And don't forget that Mobile app has a notification which keeps student up to date minute to minute.

In addition, with our application for students, you don't need to create your own website or application for each team. We are in massification university. To make things simpler, we presented this solution, one of which is a mobile app based on the management system for MRP, with all teams and other roles in the same platform, but everyone has their own access to their team or whether their supervisor has a link with any team.

Note: Please keep in mind that this is just an abstract of what we have suggested. Our system will have its own part called "Part II"

2.3.5 Conclusion

In this section we are interested in IT assistant MRP style, we have introduced an integrated system that we have based on UCD. We provided our students with a mobile application and a responsive website for our supervisors and other roles. To put it simply, we don't require each team to work on its own environment, but everything will be clear even if we don't describe how to open the door.

2.4 MRP2.0 : The New Dimension

Papert's[8] notion that engaging students by starting with the practical and solving hands-on, real-world problems is a wonderful motivator is being echoed by educators. Finally, they believe that PjBL that bridges disciplines gives a better education than traditional methods (Doppelt, 2003). As we mentioned MRP a broadly applicable PjBL so it motivates students. Our research question is, Is an additional motivating boost required for MRP? MRP is heavy-handed when it comes to official matters, We investigated the matter at our university (IKU), and came to a conclusion after interviewing more than 50 students regarding the cause of their failure. The majority of the responses revolved around the question, "What are we going to do after graduation?",It is interesting that many students who succeeded as "excellent students", and even graduates, all agreed on the same answer. This topic prompted a range of questions for us, including the fact that MRP is motivating and successful, but given the Algerian mentality,

[8] https://en.wikipedia.org/wiki/Seymour_Papert

particularly IKU, MRP has to reconsider the motivational component.

2.4.1 Real-World issues motivate students in our context

As said by Ivan Pavlov[9] *"Never think that you already know all. However highly you are appraised, always have the courage to say to yourself - I am ignorant."* This quote may apply to those who believe in their self-efficacy[10] or are naturally motivated. When asked, "What is the motivation?" , Vroom[11] argued that motivation is influenced by an individual's belief that a specific degree of effort would result in the desired performance objective. For example, if you do not feel that extending your study time would greatly improve your test grade, you will most likely not study any harder than normal. Employee motivation is also impacted by his or her projected possibilities of obtaining various outcomes as a result of meeting his or her performance objective. Finally, people are driven because they value the results (i.e. rewards) they obtain (Vroom, 1964).

Motivation, according to Richard M Ryan and Rolland Viau (Ryan and Deci, 2020; Viau and Louis, 1997), is the reason for people's activities, willingness, and ambitions. Motivation is what drives a person's behavior, or what leads a person to wish to repeat a behavior, a collection of forces that act behind the reasons. Extrinsic motivation is inspired by persons, events, or external incentives, but intrinsic motivation is inspired by within the individual.

Despite the fact that they followed the same route, Viau and Ryan proposed their own innovative motivation models. Richard M Ryan proposed Self-determination theory (SDT) is a wide approach for understanding elements that assist or undermine intrinsic motivation, autonomous extrinsic motivation, and psychological wellness, all of which are directly relevant to educational contexts. Furthermore, they highlight a dynamic relationship between teacher and student motivation, as instructors are influenced and restrained by governing mandates, institutional constraints, and leadership styles. Richard M Ryan highlights three aspects of motivation: autonomy, competence, and relatedness (Ryan and Deci, 2020)

Given the links between what Viau and Ryan presented, we will focus our research on Viau's a sociocognitive model of students' motivational dynamics.This model combines three main aspects of student motivation (the students' perception of the value of a learning activity, their

[9] https://en.wikipedia.org/wiki/Ivan_Pavlov
[10] self-efficacy is the individual's faith in his own ability to attain his goals.
[11] https://en.wikipedia.org/wiki/Victor_Vroom

perception of their own competence, and their perception of their own ability to control the process and its consequences), two learning behaviors (cognitive engagement and perseverance), and a performance measure (Viau and Louis, 1997).

2.4.2 Rolland Viau's Theory for motivation

According to Viau and Louis (1997) Motivation stems from the interaction between a person's perceptions and his developing circumstances. The following are the context-specific perceptions that are the most significant sources of motivation:

- the person's perception of the activity's value.
- the person's perception of his own competence in completing the activity.
- the person's perception of the control of the activity.

Figure 2.2 displays connect the many components involved. The interactions between these components provide the motivating dynamic that animates the learner in class. Motivational dynamics in the classroom can be handled from a variety of perspectives. Indeed, this dynamic is based on the techniques of evaluation used in the structures of rewards and implementations in the classroom, the interpersonal relationships between the supervisor and his students, and the learning activities connected to the subject (Viau, 1994).

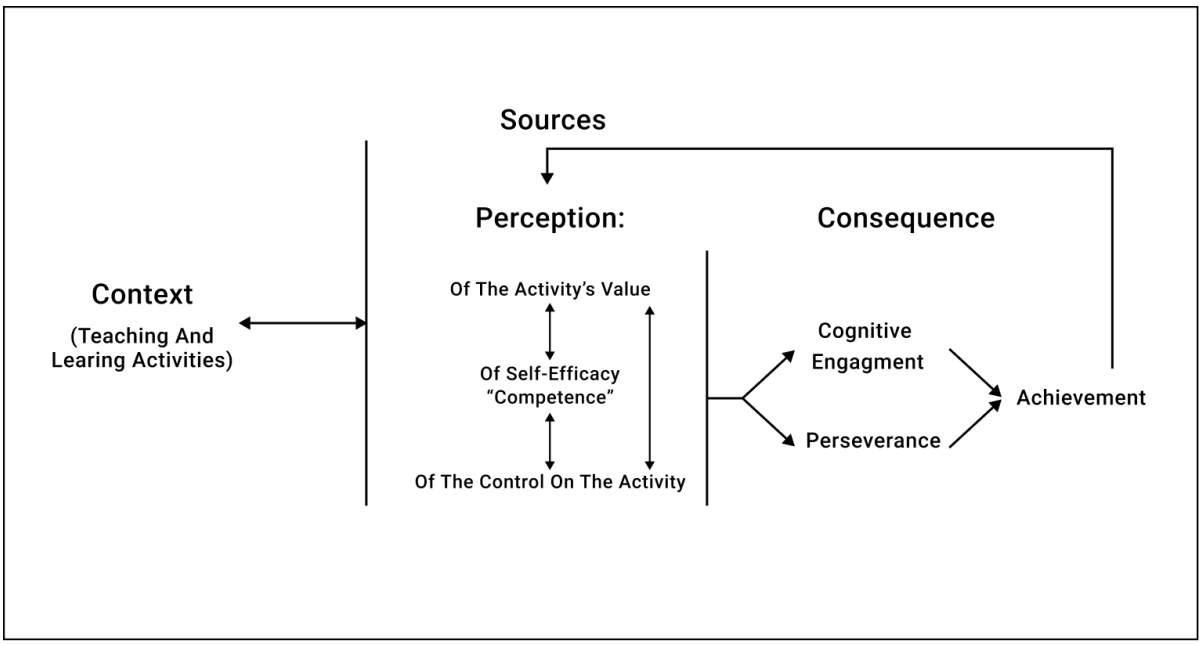

Figure 2.2: Motivational Dynamic, translated from (Viau, 1994)

The decision one makes on the importance and interest an activity has for the goals he is currently pursuing is the person's perception of an activity's value. Some people are interested in obtaining knowledge and skills, which relates to the concept of intrinsic motivation, but others are drawn to an activity because it may provide them with external incentives, such as prizes, commendations, and money, which corresponds to extrinsic motivation. Viau argues that the line between the two groups is difficult to define, thus the emphasis must remain on one's future prospects.These perspectives have a direct impact on cognitive engagement in a certain activity. Those with long-term goals are more capable of appreciating the worth of an activity even if it does not provide instant enjoyment. Those with a restricted perspective, reduced clarity, and less specified goals, on the other hand, lack a frame of reference for appropriately measuring the worth of an activity, particularly if it does not provide instant benefits. Metacognition[12] is also vital in perceiving one's own mental capacities and thought (Bandura and Watts, 1996; Viau and Louis, 1997)

Every one of these perceptions must be positive in order for the student to commit to achieving the goal. If even one of them is negative, the most likely conclusion is that the individual will not pursue the activity. Following the decision, accomplishment requires both cognitive engagement and perseverance. Approach styles varies from person to person, but a balance is required for the work to be accomplished successfully.

As previously stated, we will use the motivational dynamic theory in our research at Algerian Universities, particularly IKU. In the next subsection, we evaluate the many experiences we had in our life through the lens of the socio-cognitive model[13] of students' motivational dynamics as IKU students.

2.4.3 Motivational Dynamics Graph

In our research, we decided to evaluate different experiences We had in our life from the point of view of a socio-cognitive model of students' motivational dynamics. To do this, we devised something called the motivational dynamics graph. Along the y-axis, you have a scale from 0 to 10, and along the x-axis you have, of course, three main aspects of student motivation[14].

[12]Metacognition is, put simply, it refers to the processes used to plan, monitor, and assess one's understanding and performance. Metacognition includes a critical awareness of a) one's thinking and learning and b) oneself as a thinker and learner.

[13]Social Cognitive Theory (SCT) describes the influence of individual experiences, the actions of others, and environmental factors on individual health behaviors.

[14]This graph is inspired by Jinsub Lee's Five Senses Theory. https://www.re-thinkingthefuture

Figure 2.3 shows the rate of evaluation of different experiences, whether in university, using a socio-cognitive model of students' motivational dynamics graph. So here are some result:

(a) The first is that we do a mini project in class that, as shown in the graph, is below average in the perspective of demonstrating the value of the activity. It was a fair assessment of the competence. We knew exactly what we were doing. The sense of control was a killer; it wasn't tough, but it seemed like we were following in the footsteps of those around us and we don't like to follow in footsteps. we like to learn from the footsteps that came before us and forge a new path.

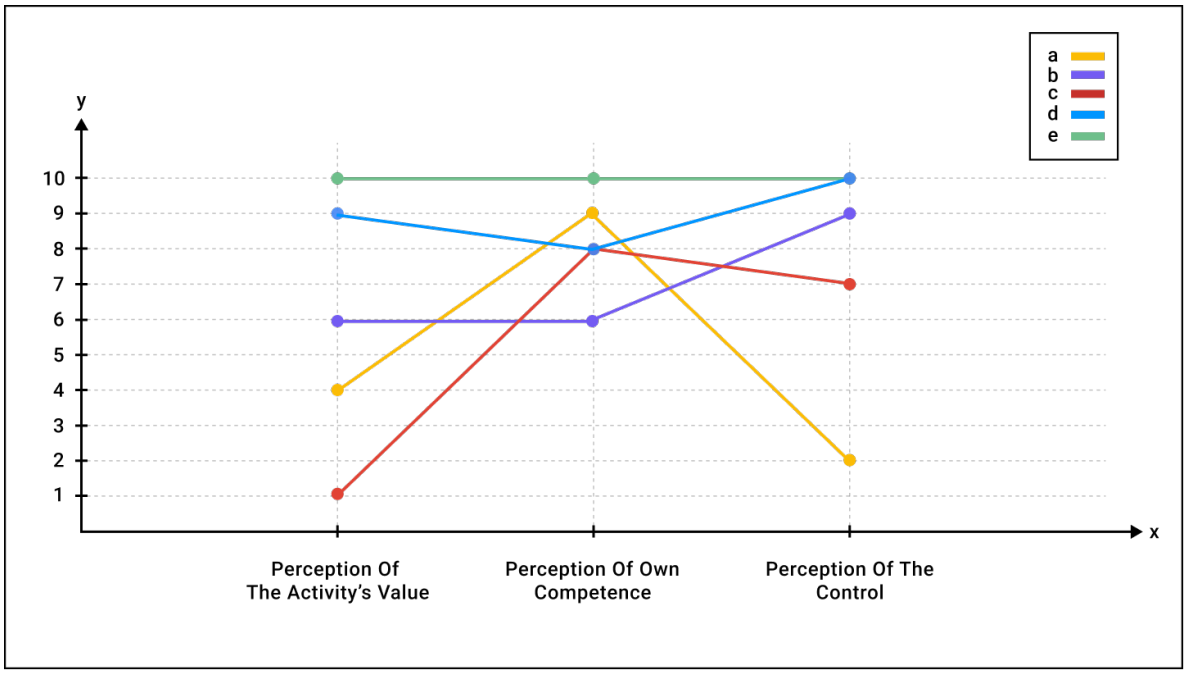

Figure 2.3: Motivation Dynamics Graph

(b) The second is to write a conference paper, now obviously the results showed above average. perception of the control is quite high. It was like having an adventure for the first time. We were a bit afraid of our abilities so our perception of our own competence and perception of the activity's value are both six. It was a great start for us, and we accomplished a lot in just a few days.

(c) The third is to practice the MRP method, Now obviously perception of own competence and perception of the control are quite high, Good news, isn't it? but the perception of the activity's value is at 1. This is what prevents us from answering the question. What

.com/rtf-architectural-reviews/a2898-tedtalk-for-architects-design-for-all-5-senses-by-jinsop-lee/

are our plans after graduation? Because MRP will not sufficiently stimulate the Algerian mentality, on the contrary, being heavy-handed the results may be unsatisfactory; This question provided us with the motivation to continue our research.

(d) The fourth, we're doing right now is writing a master's graduate thesis. for our graduation. Now obviously perception of the activity's value, perception of own competence and perception of the control are quite high, we have competence, our supervisor made us feel that we are free. This increased our enthusiasm, and The most important thing is our perception of the activity's value we didn't feel that it was just a graduation thesis, but we believe that it is a system for our Universities that might motivate others to be creative, All of these perceptions were positive so we are committed to achieving the goal.

(e) Now what would the perfect motivation look like on the Motivation Dynamics Graph?, it would of course be a horizontal line along the top.

The results showed that MRP lacks perception of the activity's value to achieve motivation, especially in the context of the Algerian University, so by applying Intrinsic and Extrinsic Motivation Theory What is the Possible solution?. In the next subsection, we will suggest a solution that will take MRP to the next level.

2.4.4 The new dimension

Although intrinsic motivation is clearly an essential type of motivation, the most of activities students engage in are not intrinsically motivated. Psychologists and sociologists have long emphasized the importance of intrinsic and extrinsic motivation (Bénabou and Tirole, 2003). In schools, for example, it appears that intrinsic drive weakens with each grade level. Extrinsic motivation is a concept that applies whenever an action is performed in order to achieve a distinct consequence. Some perspectives that view extrinsically motivated behavior as invariantly nonautonomous, According to SDT, the degree to which extrinsic incentive is autonomous might vary substantially. For example, a student who performs his homework only to escape parental consequences for failing to do so is extrinsically driven since he is performing the job to achieve the separate end of avoiding sanctions. whereas involves mere compliance with external control (Ryan and Deci, 2000).

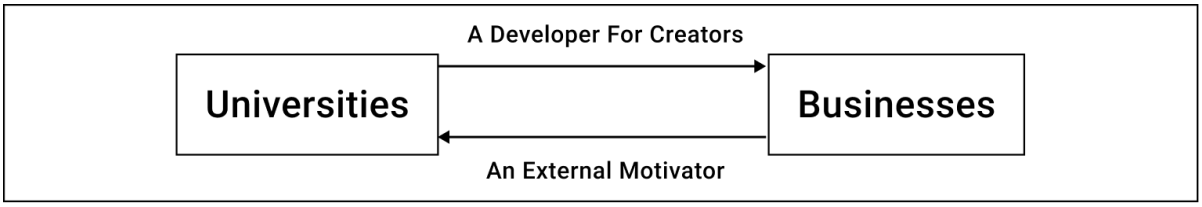

Figure 2.4: A bridge between Universities and Businesses

An extrinsic motivator may increase a student's intrinsic motivation. The external incentive may provide an answer to the research question that we discussed, namely, what happens to the student after graduation. MRP offers students with educational goals for the 21 century. That equips students with two hard skills, problem-solving and teamwork.

As a result, it might be appealing for the entire globe to scout new abilities. As a response, we proposed connecting the Universities with "Businesses" from the outside world , we build a bridge between Universities and Businesses which is shown in Figure 2.4 Businesses, as previously said, act as a motivator for students. What do you think? A new role will be introduced to the MRP. It will engage in role-playing. It plays the role as an external incentive for the learner and influences their sense of the activity's value.

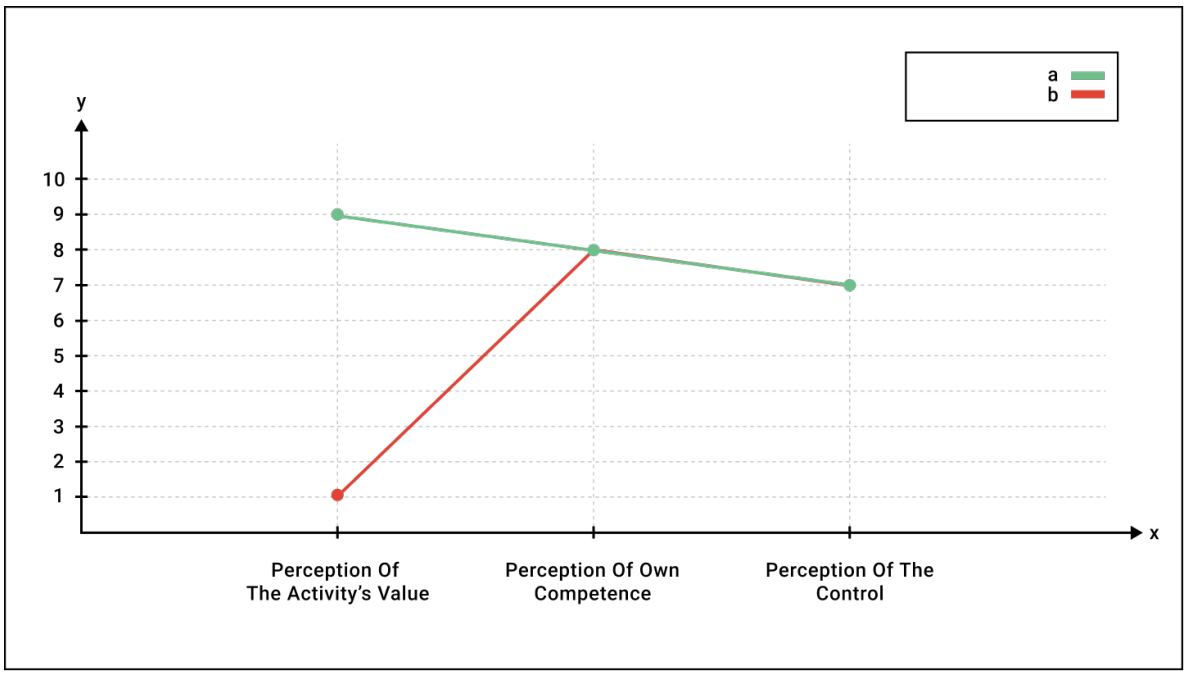

Figure 2.5: MRP 2.0 Motivation Dynamics Graph

His sense of the activity's value, when the student knows that his involvement in the MRP is

monitored by what we termed [15].

As a result, when the student feels the value of the activity, we will notice in the Figure 2.5 the difference between MRP before (a) and after (b) that the perception of the activity's value is at 9. That's what makes perception of the activity's value, perception of own competence and perception of the control are quite high, and motivation appears to be close to perfect.

2.5 Synthesis

This section introduces the MRP2.0 method, which extends the MRP method to STEM courses. Furthermore, the MRP2.0 method is built on a meta-principle that involves the project learning activity as a role-playing game that is based on two projects: a learning project and an engineering project. We investigated MRP in terms of the motivating perspectives of Algerian students, and as a result, MRP took It corresponds to the concept of responsibility at work in MRP, and the concepts of game and role are described as follows. A game is made up of a set of rules that allow players to interact with each other in order to achieve a goal; we have discussed all of the roles in the game 1.3.2.2:

- **The Scouts** are in charge of finding, identifying, and hiring talented people for Businesses. Scout work acts as a scout and is the scout's goal in MRP2.0, in addition to the scout's indirect role as an external motivator. All teams will keep an eye on each individual who is in charge of a specific topic. The statistics of the team will be presented to him step by step, and when he wants to move on to the next step, which is to see details, he will send the request that he is interested, and this will show the team that there is someone interested in their work as a team and as individuals. on a new dimension. the fifth role.

  A number of scouts may be interested in the team. Each team will have a number of scouts interested in it, creating competition or challenges between the team and other teams, as well as among team members to attract outward recognition that represents the role, the scout. As a result, the Student will understand the significance of the activity's value in which the StudentÂ is involved. If the Student realizes the job opportunities available to him.

[15] Talent scouts are responsible for sourcing, identifying, and acquiring talented individuals for companies in the entertainment and sporting industries.

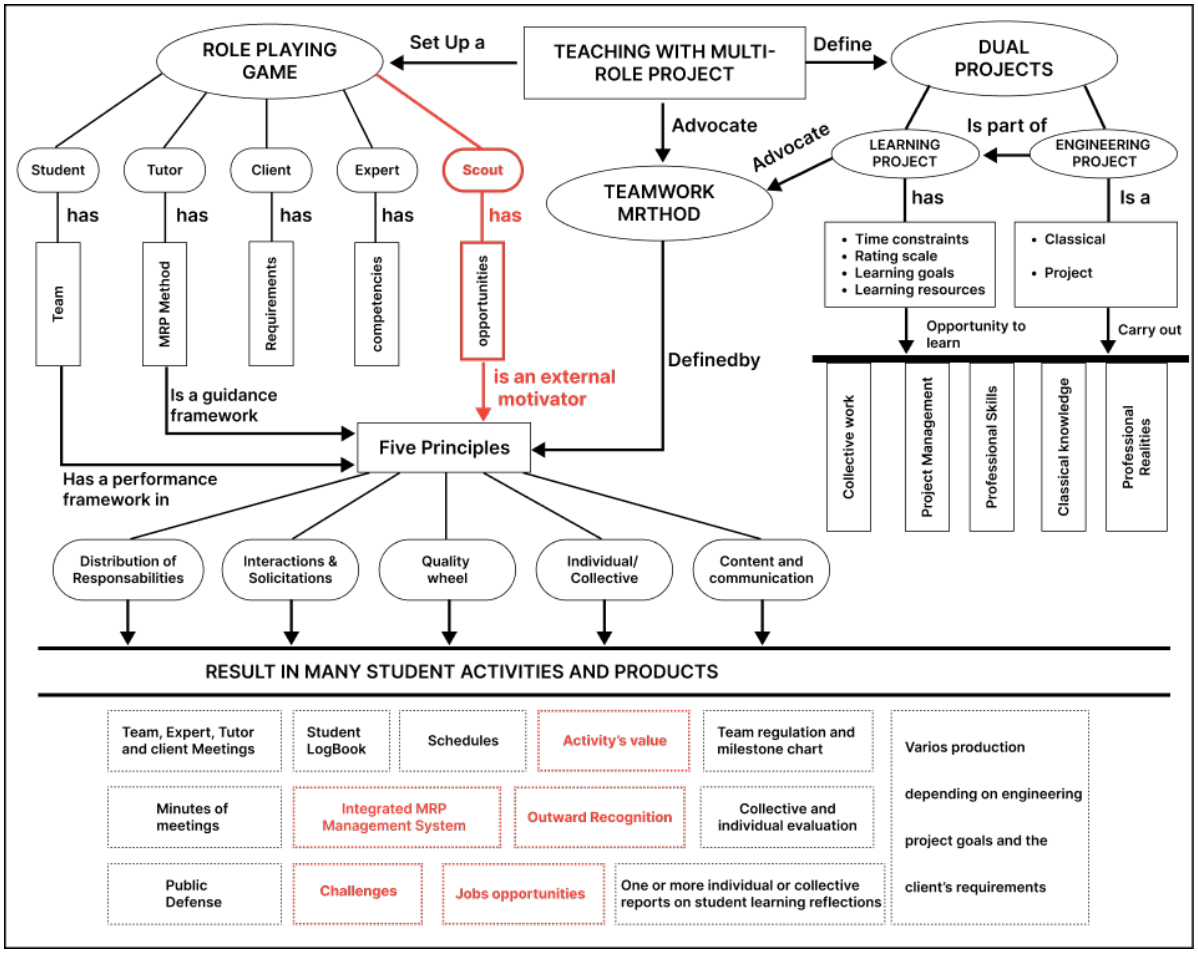

Figure 2.6: MRP2.0 Overview

Figure 2.6 shows the connections between the meta principle, the five principles, the participants, the work required of student teams, and the new dimension.

However, in order to implement MRP2.0's fifth principle of open communication and content management, teamwork must be built on open communication, as it does not yet have interactions. Rather, it was limited to team interactions, which is insufficient. In 1966 sociologists Peter Berger and Thomas Luckmann wrote The Social Construction of Reality. They argued in it that humans and human interaction, which they call habitualization, create society. "Any action that is repeated frequently becomes cast into a pattern, which can then be... performed again in the future in the same manner and with the same effort," (Berger Peter and Luckmann, 1966).

2.6 Conclusion

In the first section of this chapter, we presented the MRP needs, we asked some questions that we will think can be a source of weakness in the MRP workflow. We have shown that the questions offer a different vision of MRP When applied at the Algerian University. In the second section of this chapter, we presented a proposed new tool for the MRP method that we have advocated according to the UCD and showed which generation is using it and then give an overview of it. in the third section of this chapter, we used the motivational dynamic theory in our research at Algerian Universities, particularly the IKU, we highlighted the lack of motivation to adopt MRP. As a result, MRP has expanded to a new level, the 5th role. Finally, in the fourth section, we discussed the MRP2.0 method, which is an extension of the MRP method. Despite the fact that MRP2.0 addressed what MRP required, it still faces challenges.

In the following chapter 3, crowdsourcing will be used to improve MRP2.0 in order to address new challenges, including a lack of interactions. We will also present the final results of our research.

3 | Crowdsourcing to enhance MRP2.0

3.1 Introduction

Crowdsourcing views humans as processing units which can be integrated with computer processors to draw on the unique strengths of each (Alonso, 2011). Interaction among team members is helpful, but it is insufficient in MRP2.0. As a result, Crowdsourcing has emerged as a new learning and online collaboration paradigm, in which "crowds" of individuals may work and finish a specific task (Pan and Blevis, 2011).

In this chapter, we will (1) discuss crowdsourcing from birth to buzz, and (2) discuss crowdsourcing for education, where we will be most active. (3) crowdsourcing for innovation intelligence in a social network, as well as how we can improve MRP2.0, the subject of our research. (4) Finally, we will present our results. Stud-E.

3.2 Crowdsourcing birth to buzz

Although examples of crowdsourcing and “wisdom of the crowds” date back hundreds of years. As said by Brabham (2008) “*No one knows everything, everyone knows something and all knowledge resides in humanity; digitalisation and communication technologies must become central in this coordination of far flung genius*”. When it comes to crowdsourcing, the term has been used to refer to both historical examples *(such as the Alkali Prize from the 18th century and the 19th Oxford English Dictionary) and marketing tools (such as the DEWmocracy and Mars competitions to select new colors from MMs)*, crowdsourcing became the term for anything that involves huge groups of individuals doing anything (Brabham, 2013).

First coined by Howe in 2006 (Howe et al., 2006), the field of crowdsourcing has grown exponentially. Companies outsourced services that were previously done by workers to others by putting an open call to internet communities. Crowdsourcing was an appropriate combination since it combined two notions, outsourcing and a crowd of online laborers, to create

an altogether new word. Howe included a number of examples to demonstrate the concept of crowdsourcing. Threadless.com, InnoCentive.com, Amazon's Mechanical Turk, and Stockphoto.com are four of these situations that have become early exemplars of the crowdsourcing paradigm in studies on the topic.

Crowdsourcing, like many new phrases that appear in magazines like as wired, took off rapidly and were commonly used within days. According to Howe, a Google search for the phrase crowdsourcing increased from three results relevant to the upcoming article in one day to more than 180,000 results a week later. Today, over 16,000 results emerge in Google Scholar alone, indicating a remarkable explosion of scholarly study on the issue in just six years.

3.3 Crowdsourcing for education

3.3.1 Introduction

In an academic context, the individuals may include students, researchers, staff, etc. Crowdsourcing might be of various proportions, matching to problems or assignments i.e Students developing various aspects of a software system for a large educational software system, or multiple faculty or students or both groups developing course learning content, are just a few of the many possible scenarios (Uskov et al., 2019).

According to de Deus et al. (2017), in seeking crowdsourcing in an academic context, specifically in computer science education; specifically, they note that crowdsourcing allows the enhancement of several factors, such as teamwork, integration, support, and interactions, in a process dedicated to crowdsourcing teaching and learning to undergraduate students in computing courses.

3.3.2 Sample of crowdsourcing to enrich PjBL

Students in STEM programs get extensive knowledge in problem-solving, which must be used in appropriate circumstances. As a result, PjBL courses exist, in which students are placed in environments with projects that approximate industrial realities.

According to Diaz-Mosquera et al. (2017), and their research at the University of Catholic of Chile, At the University of Catholic Chile, there is a capstone course for 50 students in

which specified groups of 9 or 10 persons tackle real-world client needs. These circumstances put the learner under pressure to produce valuable output. As a result, team members must collaborate and use tools or platforms to support their themselves. There is an Educational Software Platform that gives UC students a variety of capabilities for project management. Working groups use this platform to store all project-related information (requirements, tasks, issues, etc.) in order to keep the project under control. Because projects sometimes need the use of platforms, languages, or technologies that the students are unfamiliar with, they must explore the web for materials that answer their questions. The issue is that they receive hundreds of links, and picking the most relevant is difficult and time-consuming for them. In the case of capstone courses, numerous concepts and technology surround the students, thus it is critical to direct them to the appropriate resources. As result they propose a Crowdsourcing Recommender Engine that collects information from the ESP on each Software engineering capstone course project in the UC and establishes a project's profile using techniques like TF-IDF[1] and LDA [2]. The CRE will then utilize the StackExchange posts dataset to apply two recommendation options, TF-IDF + Cosine Similarity and BM25 [3]. These algorithms are used to decide which postings are more relevant to previously established project profiles. There have been several studies that have used methods like TF-IDF and BM25 with intriguing outcomes.

3.3.3 Educational activities and crowdsourcing

According to Solemon et al. (2013), crowdsourcing is currently being used in many activities of higher education institutions through a variety of initiatives that may be categorized into different main crowdsourcing strategies: crowd wisdom, crowd creativity, crowdfunding, and crowd voting.

- **Collective intelligence or crowd wisdom:** Crowd wisdom involves the sharing of knowledge and the collection of ideas from the crowd in order to solve issues. This activity may involve crowdsourcing projects to request ideas in higher education.
- **Crowd creation:** When crowdsourcers are used to build or co-create a product, this form

[1]TF-IDF (term frequency-inverse document frequency) is a statistical measure that evaluates how relevant a word is to a document in a collection of documents.

[2]LDA In natural language processing, Latent Dirichlet Allocation (LDA) is a generative statistical model that explains a set of observations through unobserved groups, and each group explains why some parts of the data are similar.

[3]BM25 is a ranking function used by search engines to estimate the relevance of documents to a given search query.

of crowdsourcing occurs. Some researchers presented initiatives that use crowdsourcing to provide on-campus help, lowering the operational costs of recruiting permanent support staff.

- **Crowd funding:** In education, this refers to the effort of individuals who network and pool their money through tiny donations from numerous parties. Raising money for academic research efforts is one of the newest trends in crowd funding.
- **Crowd voting:** This refers to any method of soliciting the public's opinion, ideas, and decisions through voting. Crowd voting has been used by universities and colleges for competition-based activities.

Crowdsourcing applications can keep higher education institutions at the lead of research and education innovation. Also, crowdsourcing may be utilized to promote improved communication among students, professors, and those outside the university.

3.3.4 Crowdsourcing the curriculum

While the technology has received a lot of attention in crowdsourcing, information resources, and education. The following section discusses several current and potential crowdsourcing approaches, as well as how they may benefit E-learning environments. What Exactly Are We 'Sourcing'? According to Paulin and Haythornthwaite (2016), there are sourcing options to consider for learning:

- **Content.** Individuals tend to think of content first in educational contexts. College listservs and websites are regularly used to crowdsource resource and curriculum lists. The class sourcing strategy in E-learning helps learners improve design and collaboration abilities while also enhancing the gathering of relevant content in a specific course and to the public at large.
- **Discussion.** Learners get an understanding of how content is synthesized, and made relevant to local understanding through discussion and observation of others' experiences, thinking processes, and knowledge. E-learning promotes discussions to take place on a range of public platforms, such as Twitter, blogs, or open discussion boards, which are available to individuals outside of the E-learning and enable for external players to participate. Where the crowd learns together as experts, this process contributes to knowledge

development in the region as a whole.

- **Evaluation.** The evaluation can be done on a simpler level, such as with voting that encourages a certain source or perspective, or with rating on relevance scales for assessing content. Some perspectives on evaluating E-learning at the collective level are based on four network success factors: autonomy, variety, openness, and interaction.
- **Behavior.** Continuously evolving learning contexts require continual emergent behavior development. In online learning, this includes establishing the rules that allow a specific curriculum to run - from how regularly to post to the use of style of writing. Monitoring, regulating, and disciplining are other behaviors that must be specified for the profession.
- **Practices.** Practices develop around the usage of technology, such as the quantity and variety of media utilized, the types of communication posted across various media, and the routines and shorthands that decrease participants' collaborative effort. On an institutional level, legal and ethical problems will be resolved based on agreed understandings of privacy, security, and ownership of crowd-sourced labor outputs.

Content, discussion, evaluation, behavior, practices, Learning Analytics and assessment and feedback are all elements of curricula that can be addressed by crowdsourcing. Learning Analytics(LA) approaches have already been used in educational crowdsourcing. LA will be addressed in the next subsection.

3.3.5 Learning Analytics

Analytics is the application of data, statistical analysis, and explanatory and predictive models to obtain insights, act on complicated challenges, and make decisions. Analytics are being utilized in the context of learning to inform instructional practice and decision-making by finding patterns, correlations, and trends in learning processes, as well as to uncover factors that may effect the attainment of learning objectives and student performance. According to Viberg et al. (2018), learning analytics can improve learning practice by changing the support learning processes.Viberg's research interests are on research methodology, methods, and evidence for learning analytics. The data was scrutinized in light of four previously verified propositions: whether learning analytics i) improve learning outcomes, ii) support learning and teaching, iii) are deployed widely, and iv) are used ethically. The results indicate that there is limited evidence that shows increases in students' learning outcomes (9%) as well as learning assistance

and instruction (35%). Similarly, there was minimal support for the third (6%) and fourth (18%) propositions.

Crowdsourcing may be used to improve content presentation using learning analytics tools and approaches. The utilization of online learning content by a learning community, for example, may be studied using clustering algorithms and experimental group comparisons to discover which content, activities, paths, and presentation formats have been most beneficial for learning gains (Weld et al., 2012).

3.3.6 Conclusion

The aim of this section has been to investigate how participatory practices lead to a new perspective on learning, one that uses crowdsourcing to build and run large-scale learning companies. Crowdsourcing for education has become the focal point for large-scale online learning in this area and is the result of an integration of increased production and sharing of open content and resources online, increased interest in achieving massive collaborative learning, and a desire to provide learning opportunities freely to all those who want them. As a result, Learning is Social has become a massive gathering with a shared motivation for learning.

3.4 Crowdsourcing for innovation intelligence in a social network

From various perspectives, already many authors have explored and recommended Crowdsourcing for Collective Intelligence in a Social Network (Anderson, 2011; Hills, 2015; Saur-Amaral and Rego, 2010; Singh and Shadbolt, 2013). Let's begin with collective intelligence, accessible in global efforts and social networks that freely reflect solutions and trends. Social networks are based on free and high-visibility contributions as alternate options for collecting and integrating knowledge all over the world. Learning occurs primarily through social mechanisms. According to Anderson (2011), educational design proceeds from the growth of design techniques that rely on learning networks; the implementation of social learning techniques has spawned several successful instructional designs; collaborative projects such as project-based learning and problem-based learning; Anderson stated that students are digital natives in an era of participation. Participation in the content creation aspect of learning environments is defined

by the use of posts or discussion boards to encourage students to study and summarize key texts in a topic and to encourage (or demand) peer comments on those postings. With the advent of student portfolios, blogs and other student-created content are official.

Students created videos for a study provided by (Hills, 2015), with the purpose of giving student contributions with the ability to make real social changes. As a result, crowdsourcing expanded a lot of options for innovative approaches to educational content. Many classrooms currently utilize a variety of enhanced social communication strategies; students may connect with one another in ways that were never previously conceivable. Extensions to the current approach may include classroom Facebook groups, Twitter, and online forums, all of which would allow students to discuss ideas, questions, and suggestions concerning content created by others.

A creative approach to this somewhat 'open source' collective reflection on innovation provides for a better understanding of how social networks and ad hoc global groups of contributors solve specific innovation challenges, exchange, and integrate information about them. It manages to move above the multidisciplinarity issue of integrating dispersed conceptual bodies (e.g., social networks and Open innovation) (Saur-Amaral and Rego, 2010).

Crowdsourcing is a useful aspect of social networks in which individuals with similar interests and experience come together to solve specific issues via collective thought and form a community. It may also be used to filter out relevant information from enormous amounts of data, and gamification techniques are used to reward users for their contributions and maintain a sustainable environment for community growth. Using such methods, knowledge may be expanded, found, and combined more readily. The social network where people with similar interests and diverse experience join together to solve a shared problem and construct tools for a common goal, such as StackOverflow and StackExchange, etc (Singh and Shadbolt, 2013).

Crowdsourcing has been utilized in education and benefits it in four ways: it (1) creates educational content, (2) provides practical experience, (3) facilitates the exchange of complementary knowledge, and (4) enhances feedback. In the next section, we will present the results of our research that we called "Stud-E".

3.5 Stud-E

Stud-E is extending of MRP2.0 method that combines MRP2.0 with crowdsourcing for education. Students and supervisors on a higher level of awareness of the actual needs of our students, supervisors, universities, and the whole world. This evolved in Stud-E, a social networking system for higher education. Stud-E "/'stadi/" is just how you pronounce it, Stud-E. Stud-E has a lot of meaning. It comes from a study, and Stud-E stands for Students Growth together through E-learning. Figure 3.1 depicts approach's logo, which highlights what we discussed; it is more than just symbols, but Stud-E is more about a story that E-learning is desiring to tell that simply communicates one basic notion. What your eyes see is influenced on how you look at Stud-E logo. So whenever we design a logo, we make it a point to communicate story of idea. We keep things simple and smart.

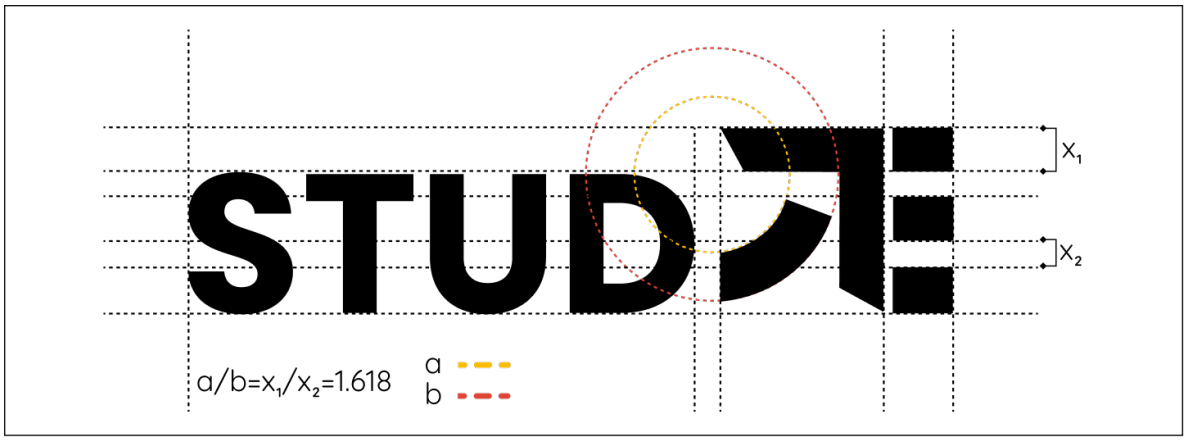

Figure 3.1: Stud-E Logo

Note: In mathematics, the golden ratio is the irrational number (1 + Square root of 5)/2, often denoted by the Greek letter or, and is approximately equal to 1.618. It is the ratio of a line segment cut into two pieces of different lengths such that the ratio of the whole segment to the longer segment equals the ratio of the longer segment to the shorter segment. Throughout history, philosophers, architects, and designers have used the ratio to create eye-catching, pleasing designs and structures. That is why it appears in the Stud-E logo.

In the next subsection, we will go through the design scenario and An Analysis of Stud-E.

3.5.1 A Design Scenario

This scenario highlighted an incentive for students to create content that helps them establish an impressive profile in their identity as a future project by combining crowdsourcing and MRP2.0 with the exchange of knowledge in what is known as educational content creation. MRP provides students with a field of knowledge linked to 21st-century skills, which includes real-world knowledge and problem solving skilled communication, collaboration, use of information and communication technology for learning, and self-regulation, Individual education can be offered, identifying topical areas that require peer support. Motivating students to assist each other means one-for-all and all-for-one. Interactions and personalities in Stud-E created student social networking. Consider the following scenario in a working prototype based on experience and influenced by scenario-based design methodologies (Rosson and Carroll, 2009):

- It's 10 pm, and Abdelhakim is working on his individual work of creating a deep learning model, and the deadline is before 15 hours. As part of being a student at a university, Abdelhakim was directed to download Stud-E app. It goes without saying that application is mandatory because it is a way for students to check their assignments, choose team who will work together, choose a graduation topic, their progress, and even their recent activities, be it comments they made or questions they've asked on a specific topic. He logs into his Stud-E account, He regularly has to check their account to see what the latest notifications from his supervisors, experts, tutors, and clients are, and he starts writing the report but he was wondering About how to fix the bug. After working on the bug set and failing to correctly Solve consecutive bugs, In our scenario, Abdelhakim gets a bit demotivated over time because the deadline is near, which is the perfect scenario and one in which Stud-E shines. One of our solutions, MRP solution brought to us by an expert, whose role and responsibility is to answer the teams' issues. he is the most suitable person often outside projects that offer skills in relation to his field, but that may be limited. Second, it's time for Crowdsourcing to shine, Abdelhakim writes about his bugs and publishes them. Stud-E system will classify Abdelhakim's post to the appropriate topic "AI." and Stud-E shares it with his peers through the feed. Menaouer replies through the bug and offers hints on how he (Menaouer) approaches the "AI" topic, At the same time, Menaouer should be friendly and informal since Abdelhakim can vote for him. Because the competition will heat up, Menaouer will not be the only one to respond, and the

others will gain from the question and answer. Even Abdelhakim will be granted points, maybe as much as Menaouer or better. This will motivate him to ask and participate again. Given what MRP2.0 performs, it also includes a scout to ensure that any activity is valued. If the other students benefited from Menaouer's response, he would get a lot of points and potentially attract a lot of scouts. he may be offered a job, There will be fierce competition, and everyone will win.

3.5.2 An analysis of Stud-E

We evaluated Stud-E in light of the existing relevant research. We followed the structure of what is Stud-E; who are the actors; why do they participate; and how is the process, which was inspired by Malone's framework for designing collective intelligence [4] systems (Jiang et al., 2018).

Figure 3.2 depicts the structure of what, who, why, and how based on our analysis of Stud-E.

- **Who?** Actors in Stud-E often play one or more of five roles: Student, Experts, Client, Tutors, and Scout. We discussed their roles in chapter 1 and chapter 2. In addition to MRP, the roles have additional types of interaction, such as knowledge exchange and evaluating peers.

- **What?** There are many contributions to Stud-E, **(1)** The first is Providing cooperation and problem-solving skills by utilizing MRP, as discussed in chapter 1. MRP is a successful method that emphasizes students' collaboration and problem-solving skills. **(2)** The second is to use MRP2.0 to build a bridge between businesses and universities, as mentioned in chapter 2. MRP2.0 extends MRP to improve motivation, thus we introduce a new position as a connector. **(3)** The third is to provide practical experience. These crowdsourcing activities are typically creative, complicated, or need specialized knowledge to deliver high-quality results. However, it is perfect for pupils to gain industrial strength training. Participating in cutting-edge initiatives also helps students to get valuable experience as an apprentice while studying. MRP, for example, may supply a customer with a product engineering project. Students can thus gain better insights into specific practical situations, improving educational outcomes.**(4)** The 4ou rth initiative enhances education by creating educational content. Such items include assessment

[4]Collective Intelligence (CI) is critical to solving many scientific, business, and other problems

materials and learning materials annotation. In Stud-E, we use some activities even use crowdsourcing to build each student profile, which includes the likes, progress replies, popularity, and so on. The idea that online crowds can be used to crowdsource learning content has shown to be promising. For example, Crowdy is a website proposed by researchers at MIT and Harvard University in 2015. **(5)** The fifth initiative focuses on the exchange of complementary knowledge. Crowdsourcing allows students to obtain help from the public online. Crowds might be more knowledgeable at times, and they share their expertise with others. In addition, we have planned a feed where academic staff will share knowledge and answer questions in Stud-E. Furthermore, the online instructor community can answer the issue of providing large-scale virtual education. This assistance comprises learning issue solutions, learning tips, and coaching to aid in the learning process. **(6)** The sixth idea uses crowdsourcing to supplement ample input for pupils. Massive enrollment increases the load on course facilitators to manage grading and feedback. inside Stud-E The student will receive feedback in the form of questions. like *How many times did you attempt to get involved in a project-related task that was not immediately within your control?* (Georgalis, 2021). Furthermore, learners providing feedback to peers expose them to new ideas and techniques utilized by peers, which improves their responsibility and autonomy to seek a more advanced and deeper comprehension of the subject matter and abilities, as well as to engage students in critical thinking.

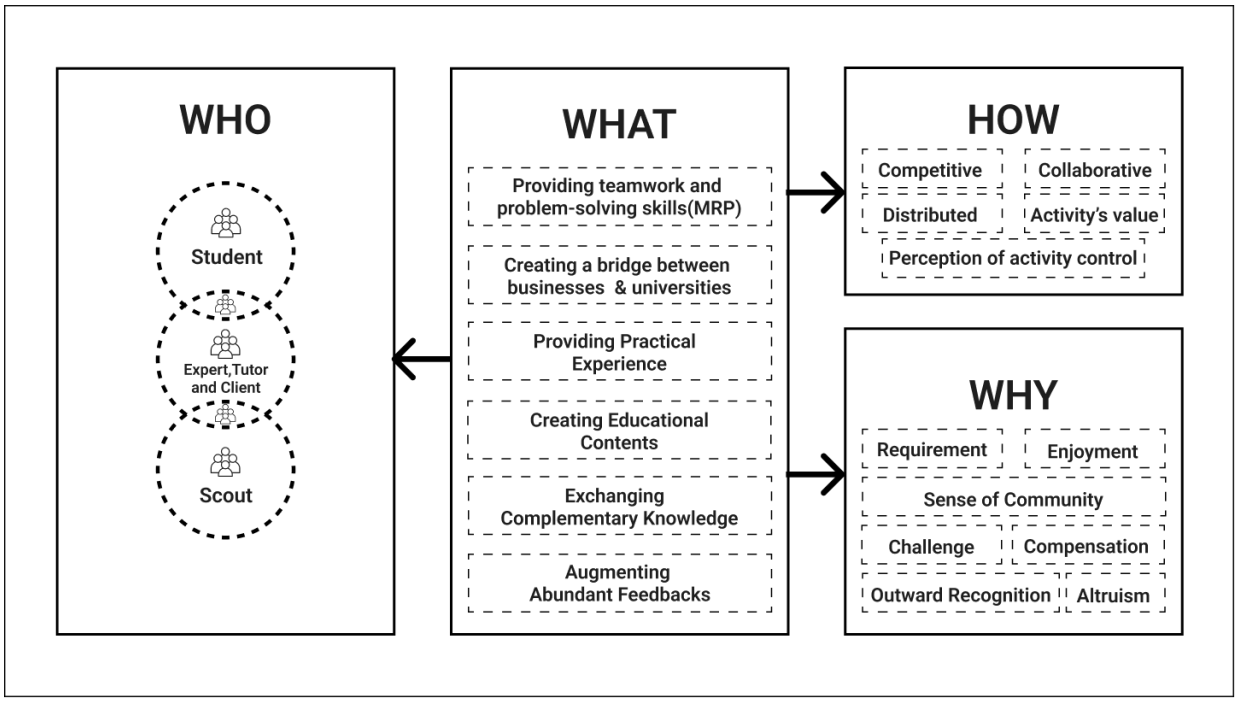

Figure 3.2: Conceptual framework of Stud-E inspired by Malone's.

- **How?** We used a modified grouping of crowdsourcing and MRP2.0 method, as well as Malone's framework for building collective intelligence systems. We discovered that they are generally distributed and collaborative, which is an MRP principle. Distributed Crowd-sourcing refers to tasks that may be broken down into little pieces and completed independently of one another (LaToza and Van Der Hoek, 2015). However, some other efforts delegate assessment responsibility to other personnel. Few initiatives also use competitive incentives to attract a highly engaged community. The topic grew more compelling in Stud-E when connecting businesses and universities with the addition of the fifth Role. With Perception of activity control, I became a valuable activity.
- **Why?** Researchers and practitioners have long been interested in what drives contributors to participate in crowdsourcing activities, because increasing motivation leads to increased effort. According to a crowdsourced review, individuals participate in CfE models for eight reasons: altruism, outward recognition, challenge, sense of community, virtual reward, monetary compensation, enjoyment, and obligation. Stud-E provides all of the above.

A particular emphasis has been placed on the research of the motivation for participating in Stud-E. Finally, when Stud-E, issues such as copyright and privacy should be considered. And careful planning is also required to make supervisors, other roles, and students feel at ease in an open environment.

3.6 Conclusion

In this Part I devoted to the state of art, (1) in chapter 1 we reviewed the work of the relevant literature, (2) our research took the approach of extending MRP method as a result of which we obtained an extended MRP method called MRP2.0 in chapter 2, and (3) we argued in this chapter that MRP2.0 extended method is stimulating but lacks some form of interaction or need to prove MRP2.0 more. that's what we presented Stud-E. Stud-E was the result of our research.

In the first section of this chapter, we review crowdsourcing from its birth to buzz, noting when the term is used. As previously stated, we combine MRP2.0 with crowdsourcing for education to obtain Stud-E. Stud-E is a social networking system for higher education to enhance MRP2.0 at Ibn khaldoun university. Stud-E is designed to motivate students to succeed and acquire 21st

century skills. However, even though MRP has so far lacked so-called realizable, how can Stud-E, as an MRP extender, inherit its benefits and challenges?

In next Part II, we will present Stud-E system from Design to Deployment.

Part II

Engineering project

4 | Stud-E System Design

4.1 Introduction

As our system could create new pathways for the e-learning domain, applying both concepts mentioned in chapter 3 and MRP2.0 method and integrating them into the system led us to mainly focus on its design so that it is fully consistent and not conflict with these concepts.

System Design (SD) requires the synthesis of knowledge from various fields, including the application domain, software system architecture, computer science, and software design methods (Guindon, 1990).

Since SD is one of the software development life cycle phases that might be most critical especially for rigorous systems like our system. It could be further broken down into 2 concepts: (1) High-level SD and (2) Low-level SD. According to Fairley (1985) High-level design describes the main software functions and subfunctions, the information flow in the system, the conceptual data structures, In other terms Low-level SD changes the High-level proposed-solution into practical and comprehensive solution.

In this chapter we will discuss the SD of Stud-E as High-level then introducing the Low-level SD.

4.2 High-level System Design

In this section, we will give a brief of Stud-E SD. In the beginning during system's conception phase we were continuously trying to design simplified architecture that fulfills our needs especially easy to deploy to production, afterwhile we reached that our system shall be a set of web services and each web service is sharded across multiple servers.

The essential web service is Communicator which used to put and fetch all data from the database, and also feed generation web service for generating feed by classifying posts to its topics.

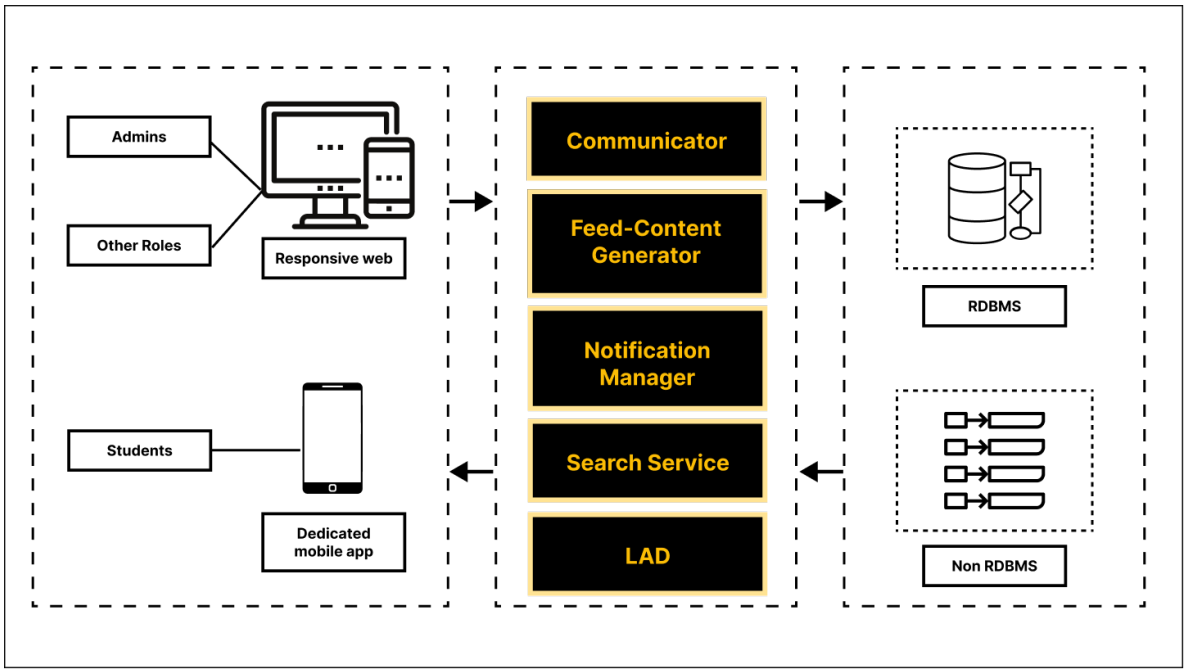

Figure 4.1: High-level SD for Stud-E

Including a search service that is responsible for the process of finding posts and users/team profiles, and also a web service for managing notifications between users. Also, we include the Learning Analytics Dashboard(LAD) which can provide students with insights into their study progress through visualizations of the students and learning data. Now we will offer a basic picture of the system architecture and how its components interact which are independent services, and each service is a set of servers that have the same goal and work simultaneously. The Figure 4.1 shows an overview about our Stud-E SD.

4.2.1 Communicator

Communicator is the essential component in the overall system which represents the intermediate layer between users and distributed databases so that users put and fetch all data that have the authorization to access it, it provides an API that facilitates securely the communication, i.e Student wants to create teams so the scenario would be as shown in Figure 4.2.

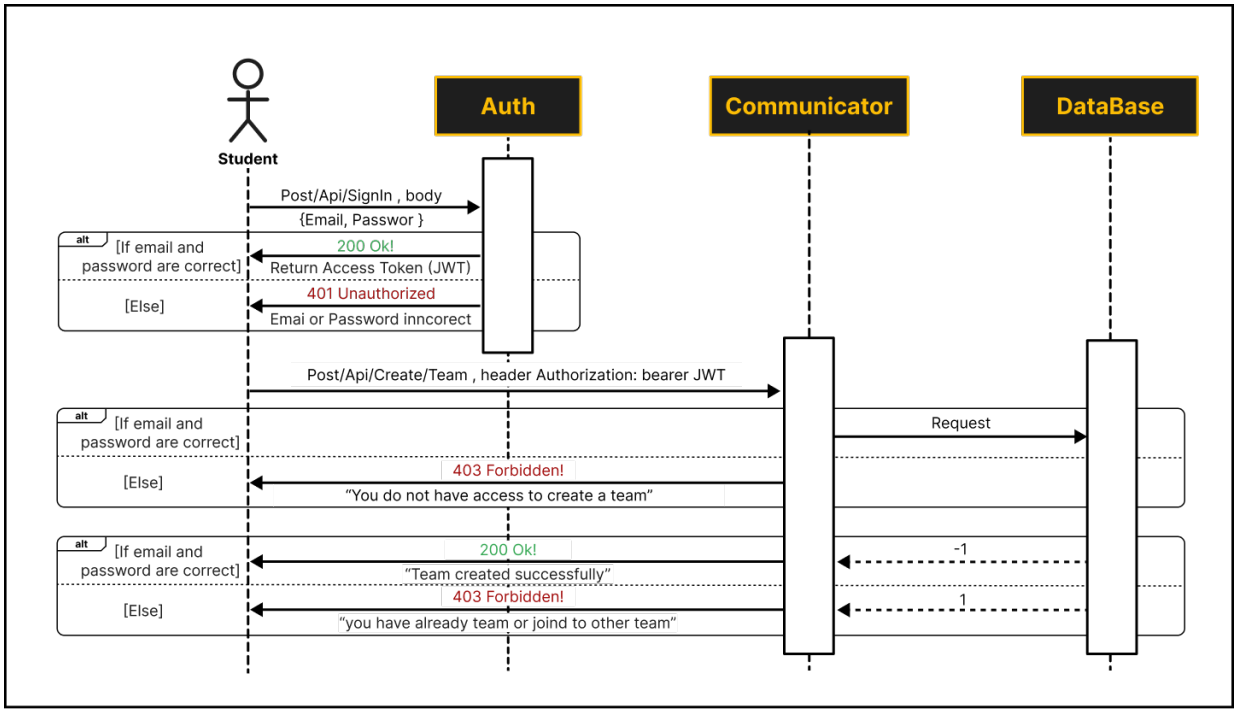

Figure 4.2: The simplified scenario of creating a team by authorized student using sequence diagram

4.2.2 Feed-Content Generator

Feed-Content Generator is the service that generates a feed for every categorized user depending on his interesting topics that have been selected previously, so when a user publishes a post the communicator will send that post to a feed-content generator that will classify to which category it belongs or approaches utilizing our classifier model then storing the post global identifier with its label in our database as key-value pair. Figure 4.7 in subsection 4.4.3 shows that.

4.2.3 Notification Manager

There are some actions done by users in the system, other users shall be notified by these actions, for that purpose we added a notification service to manage all notifications for users. **Example.** Let suppose user (A) commenting on a user's (B) post so the user (B) would be notified that user (A) has commented on his post, in that case, the comment would be stored in the database by the Communicator it would send to the Notification Manager which would create a notification for the user (A) in the database which holds the name of that user and time at which he comments after all that the notification would be sent to user's (B) device.

4.2.4 Search Service

Our search service is based on Apache Lucene Library which is an open-source search engine that provides text indexing and searching with high performance and speed, for example as of Fall 2011, Twitter uses lucene search engine, processes 250 million tweets and billions of inquiries daily, all with an average query latency of 50 milliseconds or less (Busch et al., 2012). Any time a user enters a search term, it would be sent to the search service which then returns all the posts that match its content the user's search term. During publishing any post, the post would be stored as a document file renamed with its global id and then analyzing its content and indexing it by Apache Lucene. The Figure 4.3 below shows how publishing posts in Stud-E.

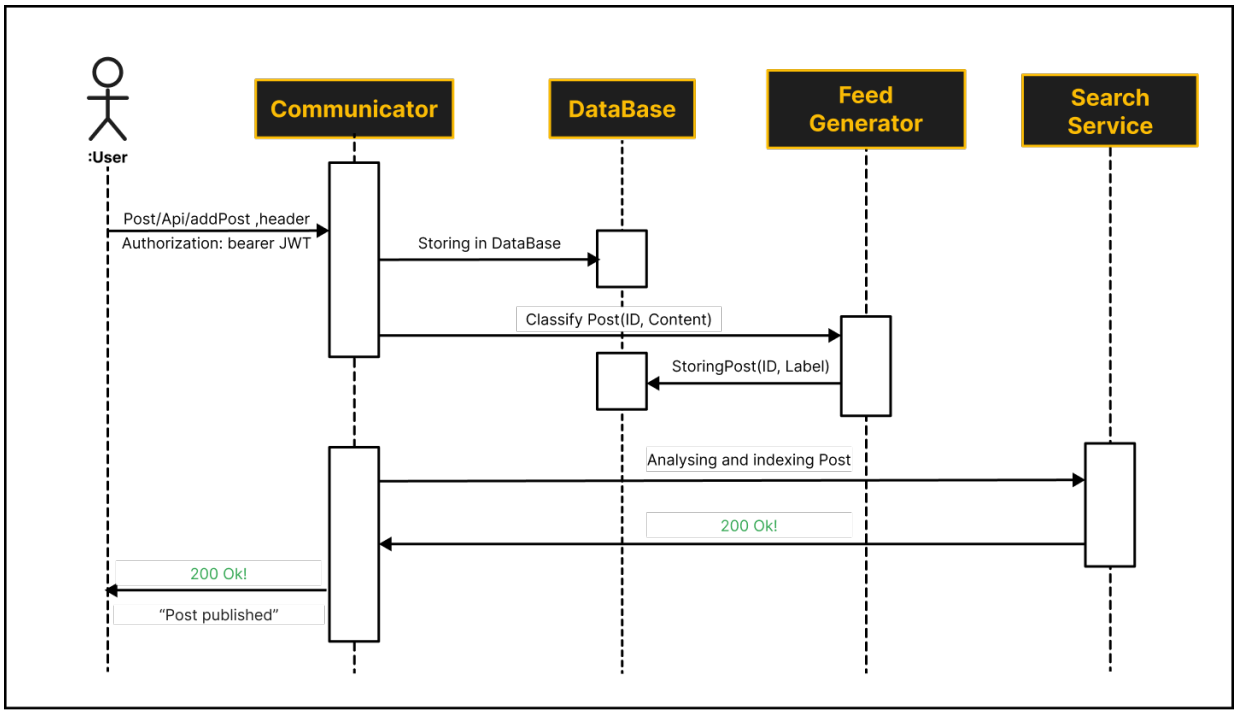

Figure 4.3: Steps of publishing posts in stud-e system using sequence diagram

4.3 Database Design

4.3.1 Introduction

Designing a database architecture is somehow challenging especially for large-scale projects, database architecture which we rely on could hold a lot of data with low database latency which is approximately negligible, also using JSON-Based table method helps us a lot in avoiding constraints i.e. missing values in different entities within the same table. All of these RDBMS

solutions are not enough to be a social network system.

In the following sub-sections, we will go through everything we need to do to create a database for Stud-E: (1) We will start with a semi-custom database, (2) then move on to JSON-based table methods, (3) and lastly, we will go through why we need all NoSQL in Stud-E.

4.3.2 Semi-customized database design

Why are not the existing relational database modeling patterns enough? As we intuitively think we were looking forward to a formal method to design database schema as a result of using these concepts. **Example.** E-R model generalization, specialization, and aggregation, we built our schema but the schema was more complicated and excessively intertwined tables and not well-fitted for crowdsourcing tasks.

One of the most widely used concepts in the E-R model is a generalization which means creating generalized entities for entities that have few similar attributes in common as Figure 4.4 shown below.

if we use this approach there would be nulled values for an entity that has not some attributes i.e. student has no 'expertise-domain' attribute, these missing values for some records in the database is not good practice when collecting data in order to create a dataset from them, also the database table would have a lot of columns half of them are useless and might affect the performance when querying the database.

A specialization is a top-down approach involved in creating sub-entities from general entities; the issue with this approach results in the complex and intertwined schema.

As Stud-E is changing rapidly depending on the context that it is used in, so every new feature needs to be integrated and requires re-changing our schema which means altering tables by adding or removing columns, instead of that when using the JSON-Based table method adding or removing new columns does not change schema because all columns reside in the JSON column as key-value pair.

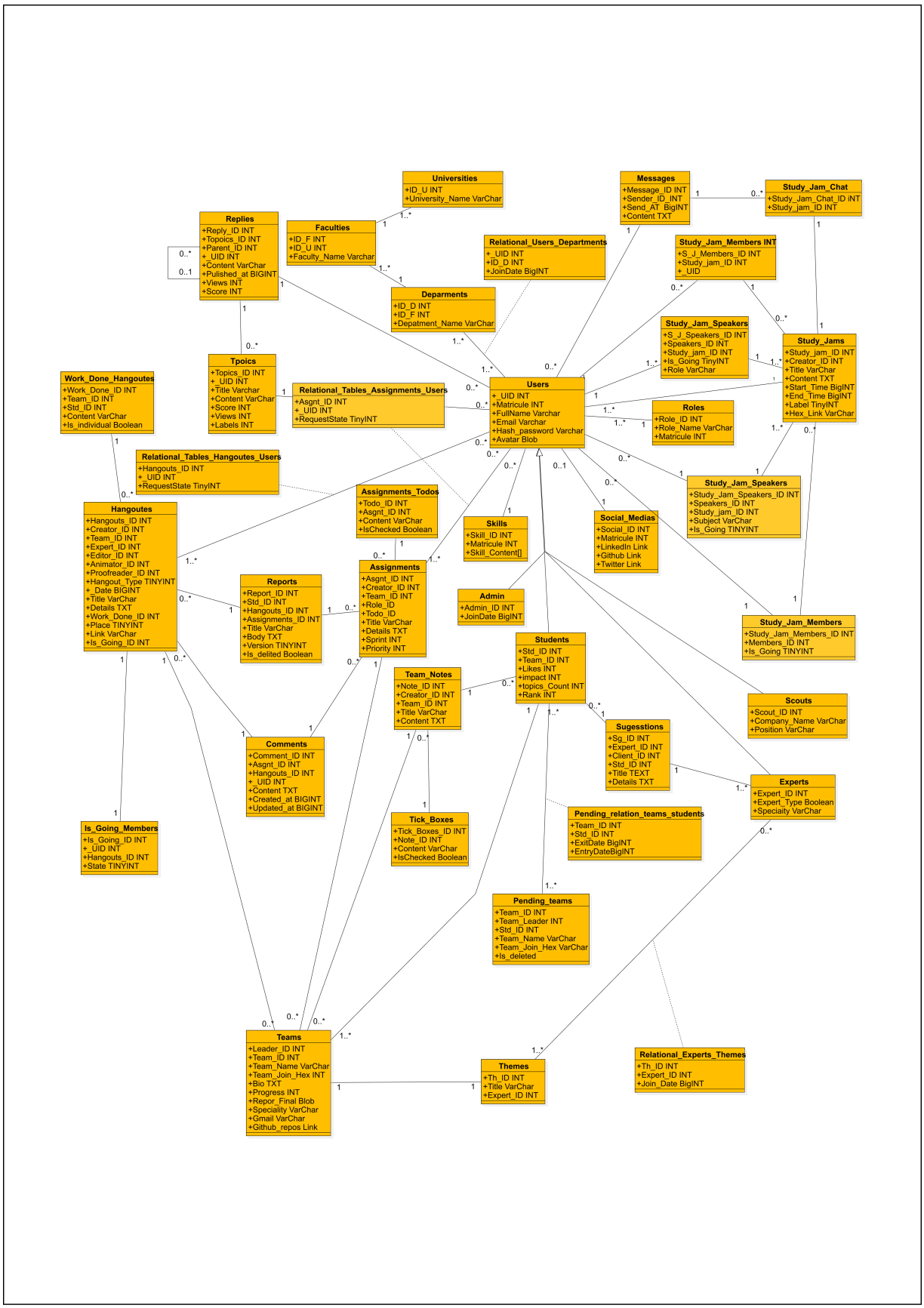

Figure 4.4: E-R model for Stud-E

4.3.3 JSON-based table method

The JSON-based table is a method that consists of grouping all columns of the table in just one column named JSON-Data as a stringified JSON object. We utilized as we named JSON-based table method because is more flexible and performant compared to the existing data modeling techniques. It has only a few columns that are needed for directly querying and stores other columns in JSON key-value pairs as string values in the "JSON-Data" column as a result of that every row in the database has own different and changeable JSON within the same table. If we have different entities we should add the column "entity-type" to specify which entity i.e. student, supervisor, or expert, and the key in the JSON object is the name of that column.

Now, when looking at the Users table, its might be wondering what is The Role-Type, and how can we hold roles in a single 64-bit integer? Instead of utilizing a role association table, we've developed a new key-value pair that bears all roles that may be assigned to a user up to 15 roles. Assume that Supervisor has n roles:

N = 2^n $role\_holder = (role1 << N)|(role2 << (N-1))|...|(roleN << 0)$

$i.e.\quad supervisor\quad has\quad two\quad roles : tutor = 1, expertJava = 2$

$role\_holder = (0001 << 4)|(0010 << 0) = 10010 = 18$

$role1 = (18 >> 4)\ \&\ 0xF = 1$

$role2 = (18 >> 0)\ \&\ 0xF = 2$

If we want to express it mathematically, this is the result: holding role equation[1].

$$\begin{aligned} v_0 &= r_n \\ v_i &= r_{n-i} * 2^{4i} + v_{i-1} \end{aligned} \tag{4.1}$$

We will give an **Example.** the supervisor takes on three roles:

1) $r_0 = 2\ \ 'Client'$.

2) $r_1 = 3\ \ 'ExpertJava'$.

3) $r_2 = 6\ \ 'ExpertAi'$

[1] $r_i :\ i\,the\,role's\,values\ ,\quad n\ : number\,of\,values\,and\quad v_n\ : is\,holding\,all\,roles\,of\,users$

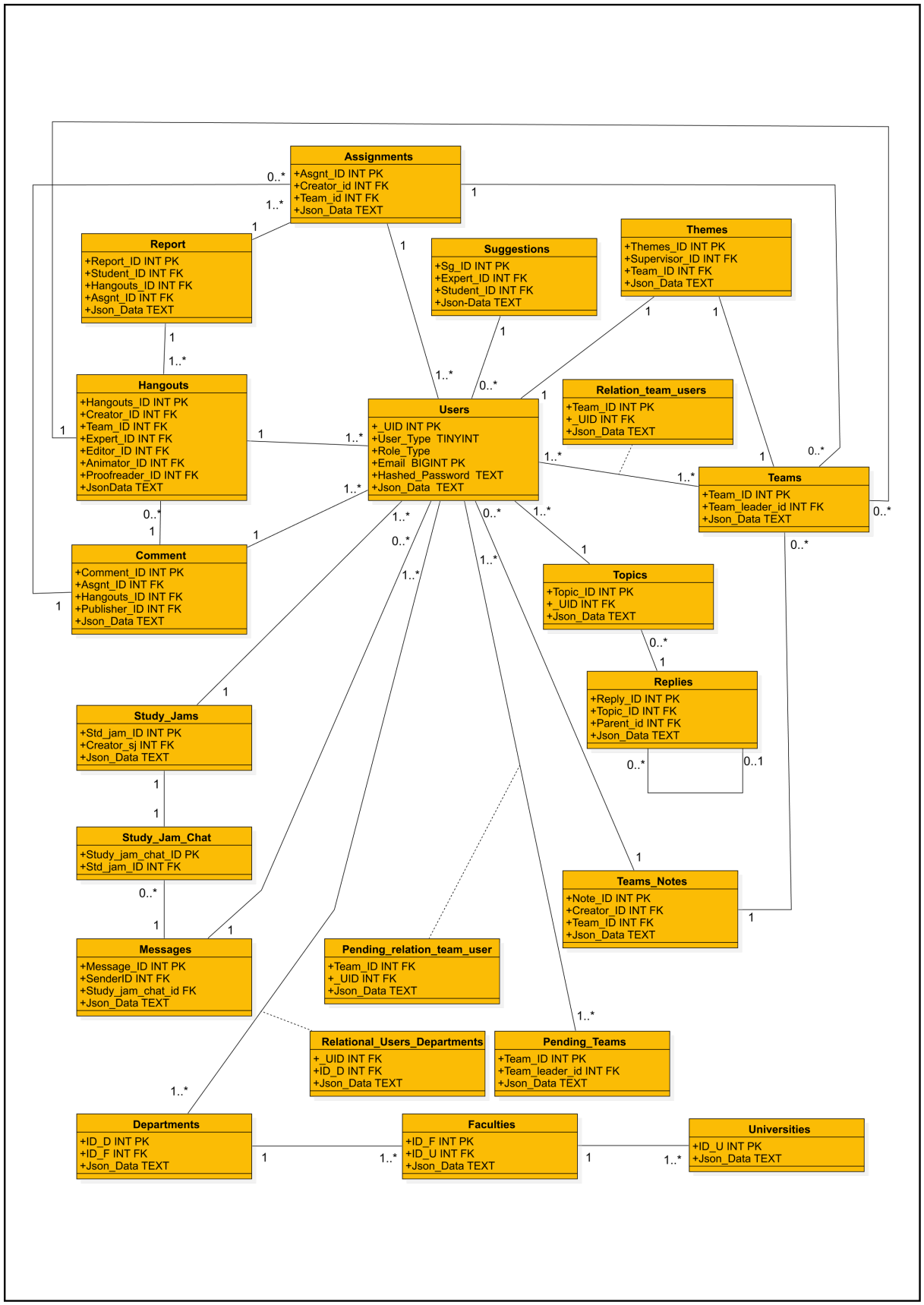

Figure 4.5: Stud-E JSON-Based table Database

$$\text{step } 01 : \mathrm{v}_0 = r_2 = 6$$

$$\text{step } 02 : \mathrm{v}_1 = r_{n-1} * 2^4 + v_{i-1} = r_{2-1=1} * 2^4 + v_0 = 3 * 16 + 6 = 54$$

$$step\,03 : v_2 = 2 * 2^8 + 54 = 2 * 256 + 54 = 566$$

Now an extracting roles equation.

$$r_i = \frac{v_{n-i} - v_{n-i-1}}{2^{4i}} \tag{4.2}$$

Example.

$$\text{step } 01 : \mathrm{r}_n = r_2 = v_0 = 6$$

$$step\,02 : r_1 = \frac{v_{n-i} - v_{n-i-1}}{2^{4i}} = \frac{v_{2-1} - v_{2-1-1}}{16} = \frac{54-6}{16} = 3$$

$$step\,03 : r_0 = \frac{v_{n-i} - v_{n-i-1}}{2^{4i}} = \frac{v_{2-0} - v_{2-0-1}}{256} = \frac{566-54}{256} = 2$$

As a result, the RDBMS solution met our requirements for dealing with static query data sets in Stud-E when compared to managing MRP approach, especially with regard to Storage, ACID, Normalization, Distributed Databases, and Data Quantity. Figure 4.5 depicts an E-R DB of Stud-E JSON-based Table.

However, in Stud-E, there are dynamic datasets related to "Feed" that wish to be moved to new Database Management Systems, and RDBMS cannot manage the increasing type, volume, velocity, and structure of new data sets.

According to Harrison (2015) NoSQL satisfies the needs of Big Data, which is so massive, quick, or complicated that RDBMS cannot handle it.

Student JSON-Data Example.

{
"Mat_id": 14011700032,
"BIO": "I'm a Software engineering student a Machine Learning Developer a Mobile Developer an Ux Designer",
"FullName": "Abdelhakim AZZOUZ",
"LinkedIn": "www.linkedin.com/in/howkmii",
"Github": "github.com/HowkMii",
"Twitter": "twitter.com/HowkMii",
"SkiLLs":["machine learning"," deep learning"],
"Speciality": "Software engineering",
"Likes_Count":342,
}

4.3.4 Stud-E Needs NoSQL

Relational databases are found to be inadequate in processing involving a very large number of servers and handling Big Data applications such as social networking, web 2.0, Business Intelligence (Padhy et al., 2011).

As Stud-E somewhat looks like social networking platform, we must incorporate NoSQL databases as part of our database design, as relying just on relational databases is inadequate. The main feed, in particular, is more convenient and performant to construct using NoSQL since the feed's posts are not chronologically arranged and are more variable over time.

For some relations (association tables) we can not query them from relational database because the records count grows rapidly even with distribution architecture i.e. user_likes_post relation which results low latency for that we have decided all relations between objects are stored in both relational database and NoSQL as a key-key-value under that pattern ("relation_name" global_object1_id : global_object2_id), whereas reads would be from NoSQL in order to increase performance rather than querying them from the relational database while complexity time of reading from NoSQL is O(1).

4.4 Intelligent System Stud-E

4.4.1 Introduction

Today, intelligent systems with artificial intelligence capabilities frequently rely on Machine Learning(ML). ML refers to a system's ability to learn from problem-specific training data in order to automate the process of developing analytical models and solving associated tasks (Janiesch et al., 2021). According to the same author, Deep learning (DL) is a ML concept based on artificial neural networks. DL models outperform shallow ML models and traditional data analysis methodologies in a wide range of applications.

In this section 4.4, we will go through how we built our intelligent system Stud-E, from how we classified posts to how we recommended it in the feed.

4.4.2 Posts Classification

To solve NLP[2] challenges, language models primarily used recurrent neural networks (RNN), Convolutional Neural Networks (CNN),and Long Short-Term Memory(LSTM). Although these models are competent, the Transformer is viewed as a huge enhancement since it doesn't require data sequences to be processed in any particular order, as RNNs ,CNNs and LSTMs do. This resulted in the creation of pre-trained models such as BERT(Bidirectional Encoder Representations from Transformers), which was trained on huge volumes of linguistic data before its release (Goldberg, 2019; Ezen-Can, 2020).

Google[3] published an open-source BERT[4] in 2018. The system obtained ground-breaking results in 11 natural language comprehension tasks during its development stages, including sentiment analysis, semantic role labeling, sentence classification, and disambiguation of polysemous words, or words with many meanings (Devlin et al., 2018). In December 2019, BERT was applied to more than 70 different languages.

So, what precisely is BERT? And how can we apply it in Stud-E?

1. BERT is a DL model in which every output element is connected to every input element

[2]Natural language processing (NLP) is a subfield of linguistics, computer science, and artificial intelligence concerned with the interactions between computers and human language, in particular how to program computers to process and analyze large amounts of natural language data.

[3]https://en.wikipedia.org/wiki/Google

[4]https://github.com/google-research/bert

and the weightings between them are dynamically determined depending on their connection. This process is called Attention[5], for more details please refer to (Shaw et al., 2018).

2. Now, we are going to look at our own dataset, which we collected from different sources like: - Interview questions etc .This dataset is already in CSV format and it has 6828 topics, each labeled under one of 10 categories: Artificial Intelligence(AI), Computer-Human Interface(CHI), Game Design(GD), Networks(NT), Computer Graphics(CG), Information Security(IS), Data Science(DS), Programming Languages(PL), Software Engineering(SE), and Systems(SYS). These labels are based on choosing the right computer science specialization. Our model will solely forecast the computer science specialization with which we began. The model analyzes and categorizes the posted content using the BERT utilizing our dataset for classified topics. Therefore the one use of BERT is to categorize a particular textual item. Figure 4.6 depicts an illustration of this form.

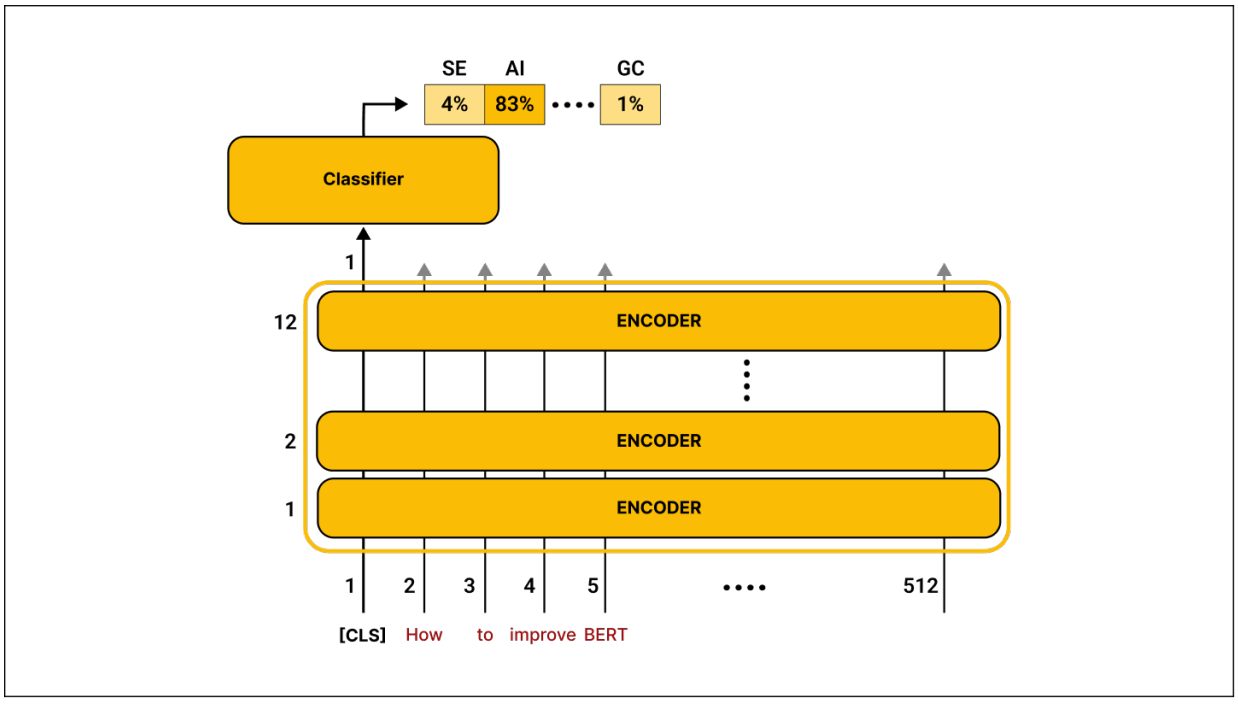

Figure 4.6: BERT model architecture for Stud-E

Since we are talking about classifiers, then we are in the supervised-learning domain of machine learning. Which we mentioned, we have our own dataset and we labeled it. For this AI classifier example, the labeled dataset would be a list of topics and a label ("AI" or "SE" for

[5]Attention is arguably one of the most powerful concepts in the deep learning field nowadays. It is based on a common-sensical intuition that we "attend to" a certain part when processing a large amount of information.

each post). Let us now look a little more closely at how BERT works. The BERT model comes in two sizes (Large and Base). Both BERT model sizes contain a significant number of encoder layers, 12 in the Base model and 24 in the Large model. BERT Base is used in Stud-E. In the input and output depicted inFigure 4.6, The initial input token is given a special [CLS] token. CLS is a stands for Classification. BERT is fed a string of words that continue to flow up the stack. Each layer applies self-attention and sends its output through a feed-forward network before passing it on to the next encoder.Now review the output. Each position produces a vector of size hidden size (768 in BERT Base), and for sentence classification, we only take the output of the first position (that we passed the special [CLS] token). This vector may now be used as the input for any classifier we choose. We have several labels (for example, "AI," "SE," "SYS," etc), and we only need to pass them via Relu.

4.4.3 Posts Ranking

Ranking, the process of ranking a list of items in such a way that the usefulness of the entire list is enhanced, is utilized in a wide range of domains, including search engines and recommender systems. Researchers frequently use a collection of supervised machine learning techniques known as Learning-To-Rank (LTR) (Liu et al., 2009).

Our recommendation feed post ranking is based on TF-Ranking(TFR), which is quick and easy to use and produces high-quality ranking models. TFR is a scalable TensorFlow[6]-based open-source[7] library for LTR (Pasumarthi et al., 2019).

Recently, TF-Ranking implemented a revolutionary TFR-BERT architecture that combines BERT with the power of LTR to maximize list ordering. According to Han et al. (2020) TFR-BERT integrates cutting-edge innovations from both pretrained language models, TFR-BERT is, nevertheless, outstanding when it comes to proposing studies on a certain topic. However, we are utilizing Apache Lucene in our research. we will start with it and see how it goes. We can try TFR-BERT again later. TF-Ranking also introduced another revolutionary advanced ranking method known as Neural Ranking Generalized Additive Models (GAM), Google researcher developed GAM, as an extension of generalized additive models to ranking issues Zhuang et al. (2021).

[6]TensorFlow is a free and open-source software library for machine learning and artificial intelligence. It can be used across a range of tasks but has a particular focus on training and inference of deep neural networks. Also TensorFlow by Google.

[7]https://github.com/tensorflow/ranking

In Stud-E, we deploy GAM as a post-ranking system, with likes, published-time, replies, and topics as primary ranking features. Figure 4.7 depicts an illustration of Stud-E posts-ranking model:

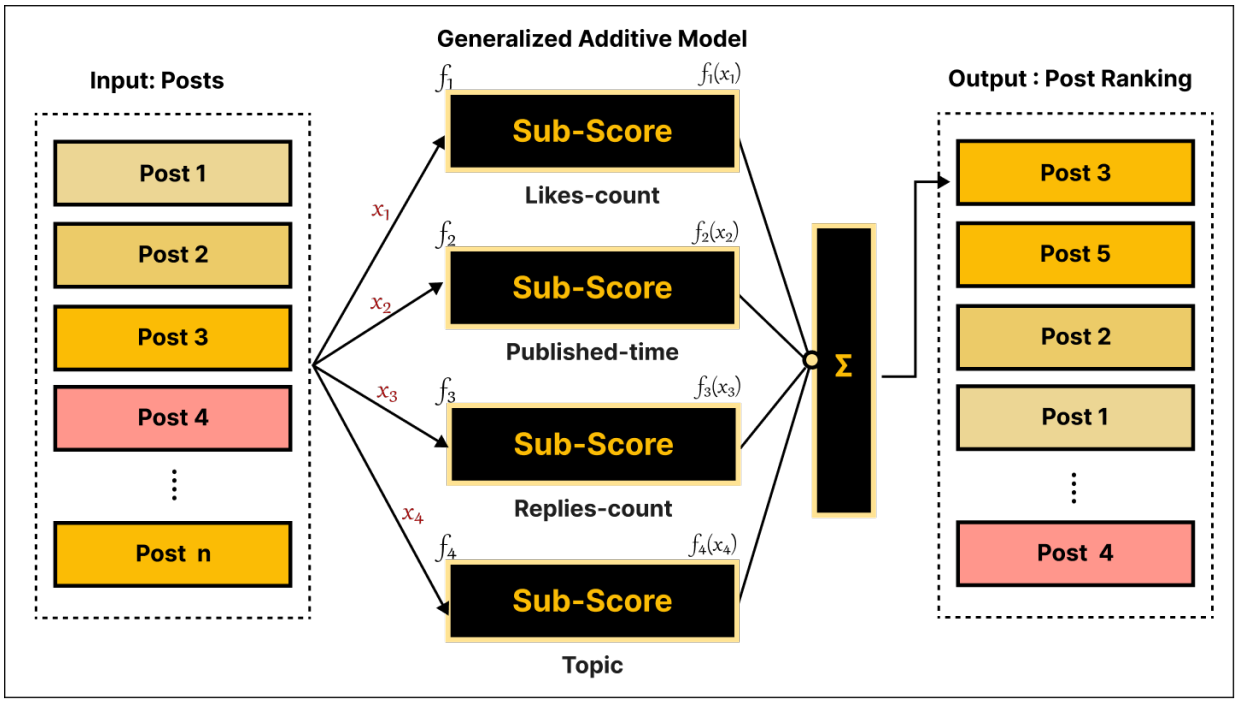

Figure 4.7: GAM architecture post ranking for Stud-E

Figure 4.7 discusses Applying neural ranking GAM for local search. For each input feature, such as ikes, published-time, replies, and topic, a sub-model produces a sub-score that can be examined, providing transparency, and as a result GAM response output item ranking.

4.4.4 Conclusion

In this section, we introduced our intelligent system Stud-E, which is based on BERT for topic classification and TFR-GAM for post recommendation.

There is a need to quickly filter, categorize, prioritize, and display important information on the Internet, where there are many options, in order to alleviate the problem of information overload and provide a good experience for IKU Students.

This problem is addressed by recommender systems, which sift through massive amounts of dynamically generated data to present users with tailored content and services.

4.5 Security

In recent years, many approaches to cryptography have evolved. which resulted in more secure information systems by encrypting communication and well-encrypting data, such as the RSA algorithm, which is used in many fields such as encrypting emails, bank online transactions, and so on.

According to Landwehr (1981), "in order to build a secure system, designers must first decide exactly what'secure' means for their particular needs." In our context, secure simply means that all users should have access only to the resources and data that they have authorization to use and that any data that is outside of their circle of authorization must be inaccessible. Additionally, user's sensitive-data must be well-encrypted so that if someone has illegally reached thes.

To prevent unauthorized access and fraud, the system should have mechanisms in place that generate a unique access token for a user who has correctly confirmed his identity, and that user would then use that token to communicate with the system. As long as the system is aware of the client's identity, the connection will be secure. Any HTTP request sent without specifying an access token in the header is considered anonymous, and the server will reject it and respond with a 401 Unauthorized error.

Since the access token can be stolen from the user's device and used by someone else and that's rarely happening so the access token must be expirable and renewable so it is necessary to have a refresh token that is used to renew the access token every time in a specified duration.

Jones et al. (2015) describe JWT as "a string representing a set of claims as a JSON object that is encoded in a JWS or JWE, enabling the claims to be digitally signed, MACed, and/or encrypted." In our case, we utilize JWT based on the RSA algorithm. One of the reasons we chose JWT is that it does not require token management like other mechanisms.

Now how does the JWT structure appear? The JWT token structure is made up of three components: the header, payload, and signature, which are encoded by the 64 baseurl algorithms.

- The header is a JSON-object that contains two key-value pairs: the kind of token and the signature algorithm used, such as HMAC, SHA256, or RSA. "alg" = "RSA", "typ" = "JWT".
- The payload typically includes information about the user, such as his ID, as well as other

information, such as the expiration date of the token. "user id": 420349, user type: 3, expiration date: 3420359434.

- A signature is used to ensure that the sender of the JWT token is the client who previously authenticated and not someone else.

A question may still arise: how does JWT work? JWT has two tasks: creating and verifying tokens. Generating a token scenario would be like that when a user submits his login information, such as an email address and password the server would check them and if they are correct, user id and other attributes would be grouped into a payload, and from that payload, a token would be generated and sent as an HTTP response.

XXXXXXXX : base64_encode(header),

YYYYYYYY: base64_encode(payload),

ZZZZZZZZ: encryption_algorithm(base64_encode (header) +"."+ base64_ encode(payload), privateKey) The generated token looks like : XXXXXXXXX.YYYYYYYYY.ZZZZZZZZZ

The Figure 4.8 below summarizes what we talked about earlier.

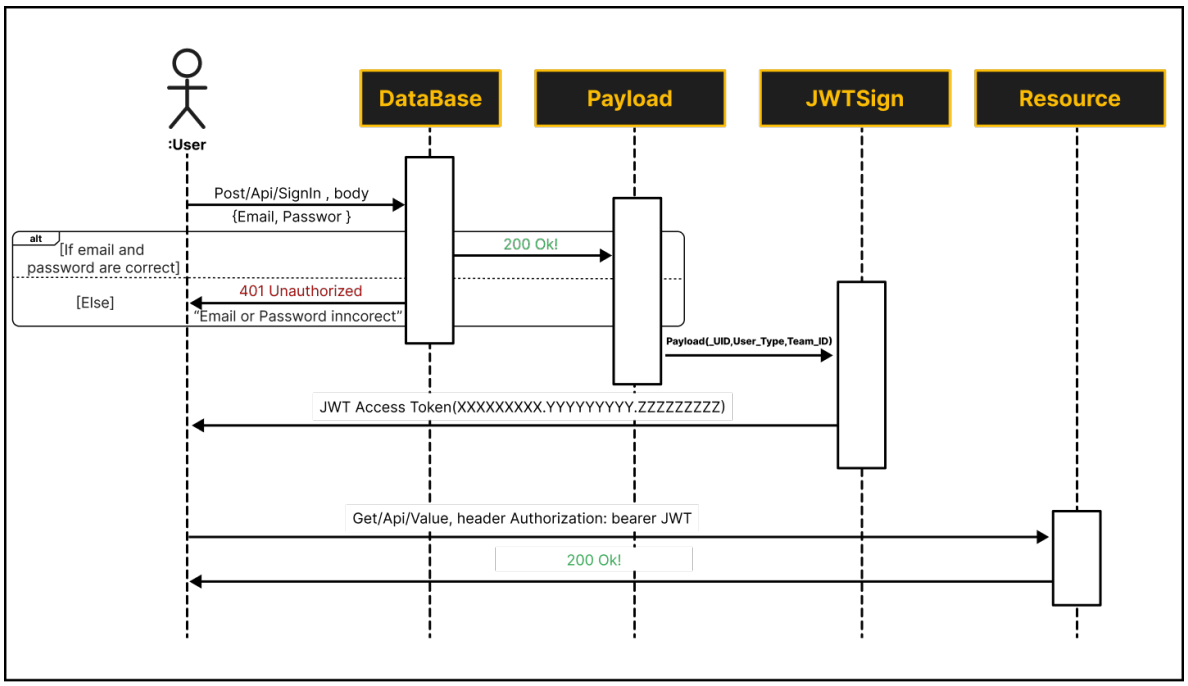

Figure 4.8: Sequence diagram for authenticating a User

Verifying user's token would like that, the server takes the signature part (ZZZZZZZZZ) of the sent token and decrypt it then if the output were header along payload and is identical to the two parts XXXXXXXXX and YYYYYYYYY, consequently, this user is the same one who has already been authenticated in this case the server would not reject user's request. XXXXXXXXX.YYYYYYYYY: decryption_algorithm(ZZZZZZZZZ, PublicKey).

Encrypting sensitive-data stored in the database If we store sensitive-data such as passwords without encrypting them, an attacker, if he breaks into the database, could steal the data easily as long as they are plain-texts, consequently he could do anything even accessing users' accounts, altering data and so forth so we need techniques to encrypt them to prevent such as actions.

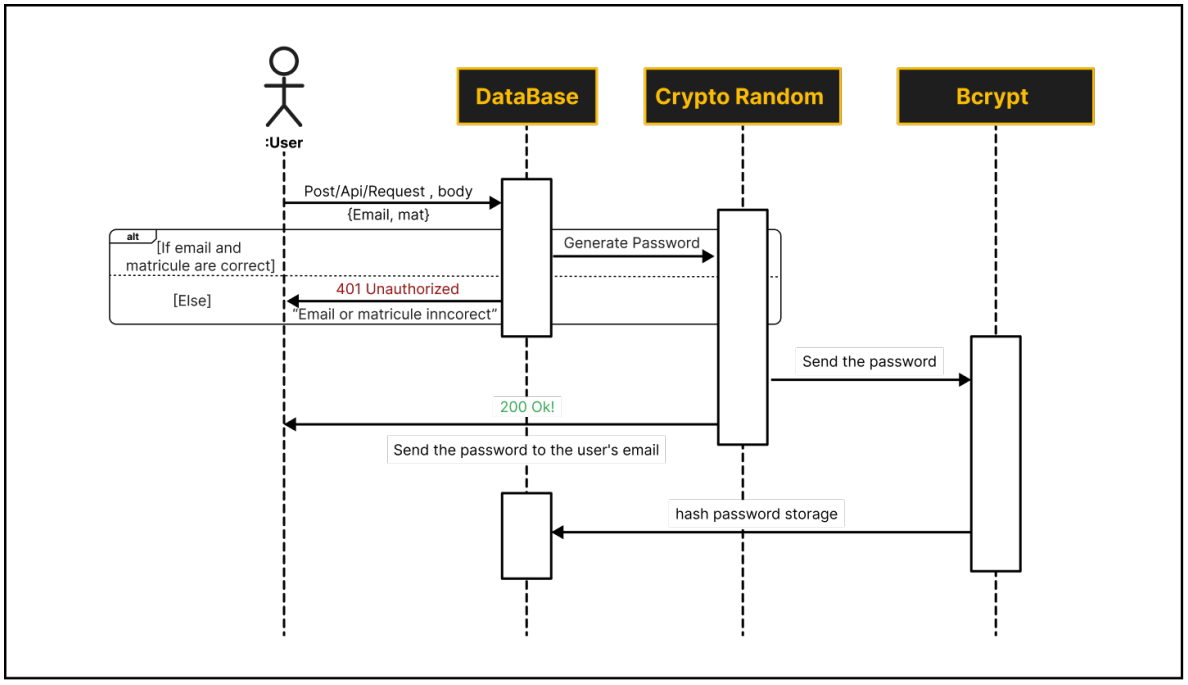

Figure 4.9: Sequence diagram of how to encrypt the password.

One of most used mechanisms in this context is using hash function, According to Damgård (1989) "A hash function h is called collision free, if it maps messages of any length to strings of some fixed length, but such that finding z, y with h(z) = h(y) is a hard problem".

In our system we have chosen bcrypt for hashing user's passwords, bcrypt is recommended by Google as one of strongest hashing functions.

4.6 Learning Analytics Dashboard

In recent years, various dashboard apps have been created to enhance learning. Such dashboards give graphical representations of the current and historical condition of a student or a course to allow flexible decision-making (Verbert et al., 2013).

According to Valle et al. (2021), predictive and descriptive Learning Analytics Dashboard(LAD) influence graduate studentsâ motivation and statistics anxiety in an online graduate-level statistics course. According to the same authors, LAD has 3 models: 1) predictive dashboard, 2) descriptive dashboard, or 3) control (i.e., no dashboard).

In our case study we would choose descriptive dashboard model for the reason that letting both of supervisor and other roles to know if a student is motivated or not and that by controlling all his traced activities which are: - Individual works, - Team works, - Commitment hangouts meeting, - Completed tasks in this hangout, and - Crowdsourcing Interaction.

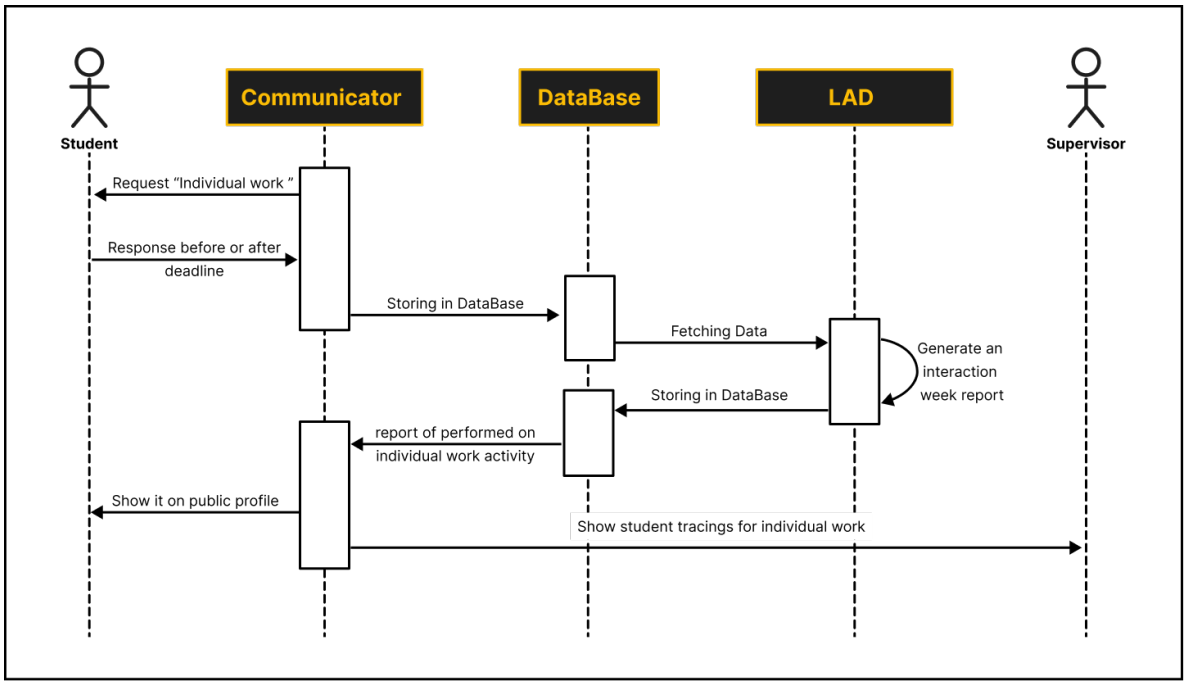

Figure 4.10: Scenario of individual work activity in the sequence diagram

We would give a scenario of individual work activity in the sequence diagram below Figure 4.10: A student has a request of individual work, in this case there are 4 possibilities which would be visualized in LAD which are: 1) Individual work completed after deadline, 2) Individual work completed within deadline, 3) Individual work completed before deadline, 4)

Individual work completed within deadline and organized by time.

All these possibilities one or more of them would be visualized in a graph which vary depends on his previous individual works.

4.7 Conclusion

In this chapter, we designed our system Stud-E. (1) We first defined the high-level SD. We saw the main software functions as services, and we define the overview of Stud-E. (2) When we start addressing Low-level SD we solved a lot of challenges, whether in the database or as an intelligent system, we mentioned that Stud-E is safe. lastly, we present the learning analytics dashboard to insights about student study progress via learning data. Finally, we saw Stud-E from a dynamic perspective, how each component interacts with the other. Our goal was to give a good experience to IKU students, but because our system is based on crowdsourcing or is a social network, this makes us face huge data.

In the next chapter 5, we will aim to boost our system with an architecture suitable for big data structures.

5 | Stud-E as Distributed System

5.1 Introduction

A distributed system is made up of numerous autonomous computing nodes that may communicate with one another and work together to complete a single activity or objective (Enslow, 1978).With the ever-growing technological expansion of the world, distributed systems are becoming more and more widespread. They are a vast and complex field of study in computer science.

A distributed system might vary depending on the context that is used in. For instance, the objective can be to offer the user a database management system; in this case, the distributed system is referred to as a distributed database (Rothnie and Goodman, 1977). In our case study, let me tell you about something in Algeria. Each university has its own system based on LMS-MOODLE, which is scattered without communication between them. We proposed Stud-E as a centralized system[1] that brings together all the universities.

In this chapter 5, (1) we will introduce Stud-E distributed system. (2) we will start with split our system into a distributed database that enables you to innovate and transform effortlessly, (3) also will apply which called database Replication to the availability of mission-critical databases and assure business continuity, (4) and finally use distributed web servers, which are generally used for sharding enables you to scale service in response to the size of the state that needs to be served. The Figure 5.1 shows an overview about our Stud-E Distributed.

[1]centralized system in Stud-E is all data and resources are stored in Stud-E servers. Note: which is not the same as MOODLE that is installed locally in each university

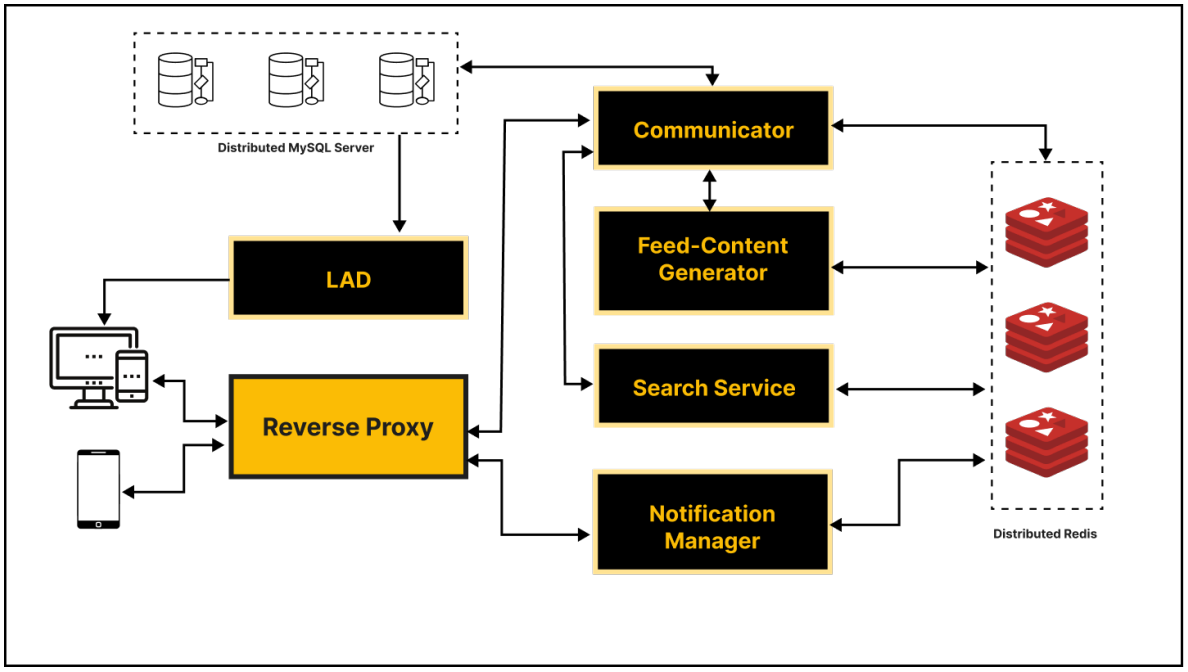

Figure 5.1: Distributed Stud-E Overview

5.2 Distributed database

5.2.1 Introduction

if we tried to use a single database in one server we would face some issues like low latency, to clarify that let us suppose we have x[2] millions user, so querying in order to bring/check one user by his identifier it might take approximately t[3] seconds as response time which may vary depends on hardware used.

Instead we decided to distribute our data uniformly to avoid low latency and other related issues, i.e. if we uniformly distributed x millions records[4] of user table over just y[5] shards[6] it would be only x/y and x>y rows for every shard and it may take in average less than t*(y/x) for querying. Our database distribution architecture is inspired by Pinterest's[8] DB design, using distribution we could easily internationalize Stud-E with high level of performance and latency.

[2] x is number of records in user table
[3] time in second
[4] record is a group of fields within a table that are relevant to a specific entity
[5] y is number of shards in all our MySQL Servers
[6] shard is a Stud-E database which has the same set of tables[7] which is identified by index.
[8] https://medium.com/p/3f341e96ca6f

In this section we will explain in depth how we distribute data across many MySQL servers and mention the techniques used.

5.2.2 Distribution of shards across servers

Each MySQL server has 256 shards (databases) that have the same set of tables and each shard is named under this pattern "Stud-E_XXXXXX" and XXXXXX is the index of the shard. All shards range from "Stud-E_000000" to "Stud-E_000255" reside in the first MySQL server, the second server its shards range from "Stud-E_000256" to "Stud-E_000511" etc.

Now, why do we need a globally unique identifier for each entity[9] in a distributed database? Let us assume a student is scrolling his feed and spontaneously click on a post/question and he starts reading the comments, technically each comment is stored in a shard independently so we cannot fetch all comments by specifying post/question identifier. If we had all data in one database, this query would be enough to show comments of a post/question **Example.** "SELECT * FROM Stud-E.comments WHERE post_id = 4302".

We intuitively ask how to fetch these comments which are stored in a distributed database.The answer is that each entity should have a globally unique identifier that indicates which shard it resides in, its type i.e. comment, user, teams ...etc. and its identifier in the table.The Figure 5.2 shows how the database is distributed to shards.

5.2.3 Generating global object identifier

Each entity in the database should have a local identifier which is its primary key in the table and a global 62 bits identifier that would be in 'JSON_Data' consisting of a shared identifier, its type and local id.

global_object_id = (shard_id « 46) | (object_type « 36) | (local_id « 0)[10]

[9] entity in DBMS is a real-world thing or a real-world object which is distinguishable from other objects in the real world.

[10] « : left-shift operation and | : OR bitwise operation

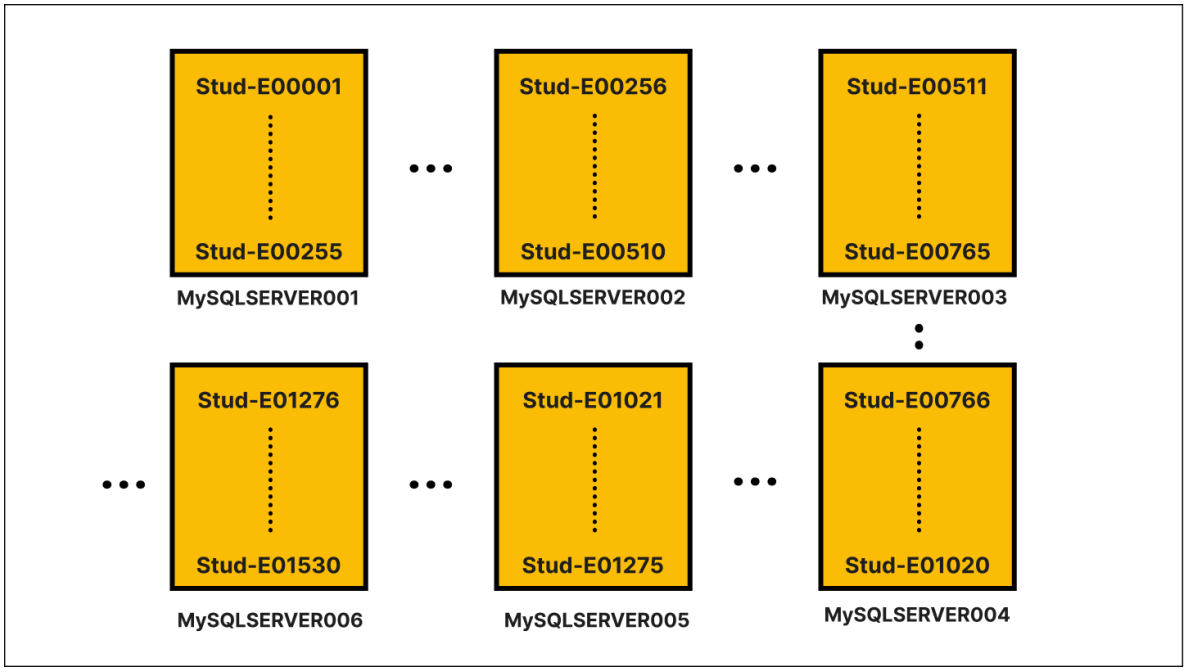

Figure 5.2: Stud-E DataBase distributed Architecture

5.2.4 Fetching object from its global identifier

Fetching an object/entity from a distributed database becomes easier when we use a global identifier. to clarify that let us assume a student wants to see the profile of his supervisor. i.e. the supervisor's global identifier is 343210430942340912. To fetch data of that supervisor:

Shard ID = (343210430942340912 » 45) & 0x1FFFF = 487[11]

Type ID = (343210430942340912 » 36) & 0x1FF = 321

Local ID = (343210430942340912 » 0) & 0xFFFFFFFFF = 6635841328

const mysql = MySQL.connect(where=shardId: 487)

const user = mysql.query('SELECT * FROM Stud-E_db_0x000487.users WHERE_uid = 6635841328')

5.3 Database Replication

5.3.1 Introduction

Database replication refers to the act of transferring data from a main database to one or more replica databases in order to increase data accessibility and system fault-tolerance and

[11] « : left-shift operation and & : AND bitwise operation

dependability. Database replication is often a continuous operation which happens in real time as data is created, updated, or deleted in the primary database but it can also occur as one-time or scheduled batch projects.

5.3.2 Benefits of Replicating Data

Data replication transports your data effectively and securely throughout the Stud-E data integration system. This allows enhancing the speed and availability of our databases and the applications that rely on them, adopting new technologies into our system.

Below are the key benefits of replicating databases for Stud-E:

- **Higher data availability.** The Stud-E system will still be able to perform adequately even if one of our replicated databases becomes unavailable because we will have a copy of the database.
- **Reduced server load.** The Stud-E system will still be able to perform adequately even if one of our replicated databases becomes unavailable because we will have a copy of the database.
- **Reduced server load.** A replicated, distributed database needs less processing for each server. This implies improved performance for queries.
- **More dependable data.** As part of the replication process, data in target systems is processed and updated to match that of the source system which helps assure data integrity.
- **Better protection.** Achieve redundancy to secure the read performance and availability of mission-critical databases and assure business continuity

5.3.3 Database Replication work in Stud-E

Each MySQL server is master-master replicated onto a backup host in case the primary fails. Our production servers only read/write to the master. It simplifies everything and avoids lagged replication bugs.

what we have to do in our system. we construct a new master-master pair with the next biggest names (say MySQLSERVER001M and S)[12] and start replicating from MySQLSERVER001M

[12]M: Master and S: Slave

.

Once replication is complete, we alter our settings such that MySQLSERVER001M only has shards 0 to 255, and MySQLSERVER002M only has 256 to 511 as we indicated in Figure 5.2. Now each server just needs to manage half the shards as it previously did. The Figure 5.3 shows how Database Replication work in Stud-E.

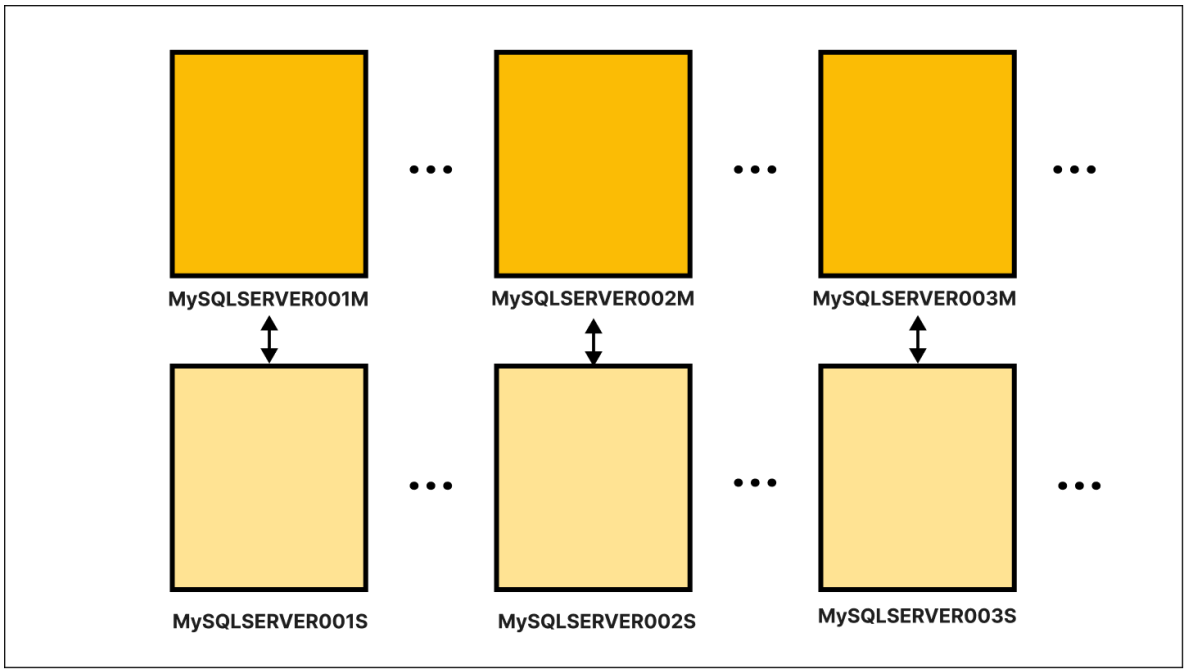

Figure 5.3: Database distributed replication architecture for Stud-E

5.4 Distributed Servers

5.4.1 Introduction

Stud-E is a set of services that interact with each other, and each service is a group of web server-app pairs that do the same function.

The issue we faced that single web server (apache or nginx) can not handle more than 256 http request coming from clients and even increasing process of web server and even enabling Multi-Processing (MPM-worker)[13] would not efficient compuning to the number of http requests that coming from Stud-E users, for that we decided to distributed our system across many web-

[13]The Apache Web Server comes with a Multi-Processing Modules (MPMs) mainly 'prefork' MPM and 'worker' MPM which are responsible for binding to network ports on the machine, accepting requests, and dispatching children to handle the requests.

server app-server pairs and distribute coming requests to them uniformly using Reverse Proxy that behaves as Load Balancer.

5.4.2 Reverse Proxy

A proxy server is a goâbetween or intermediate server that transmits requests for material from various clients to other servers throughout the Internet.

A reverse proxy server is a sort of proxy server that often resides behind the firewall in a private network and routes client requests to the proper backend server. A reverse proxy offers an extra level of abstraction and control to guarantee the smooth flow of network communication between clients and servers.

Common applications for a reverse proxy server include: Load balancing we will describe it in the next sub-section 5.4.3, Web acceleration which is reverse proxies, Web acceleration may compress incoming and outgoing data, as well as cache often requested material, both of which speed up the flow of communication between clients and servers. They may also execute extra functions like SSL encryption to reduce the burden off of your web servers, so enhancing their speed, Security & anonymity which is a reverse proxy server that protects their identities and works as extra protection against security assaults. It also guarantees that several servers may be reached from a single record locator or URL regardless of the layout of your local area network.

5.4.3 Load Balancer

Load balancing refers to efficiently dispersing incoming network traffic over a set of backend computers, commonly known as a server farm or server pool.

In the reverse proxy server, Load balancing can act as a "traffic cop," sitting in front of your backend servers and distributing client requests across a group of servers in a manner that maximizes speed and capacity utilization while ensuring no one server is overloaded, which can degrade performance. If a server goes down, the load balancer transfers traffic to the remaining live servers.

In this way, the load balancer performs several functions such as distributing client requests[14],

[14]Distributes client requests or network load efficiently across multiple servers

Ensuring high availability[15], and providing flexibility[16].

Figure 5.4 shows load balancer diagram.

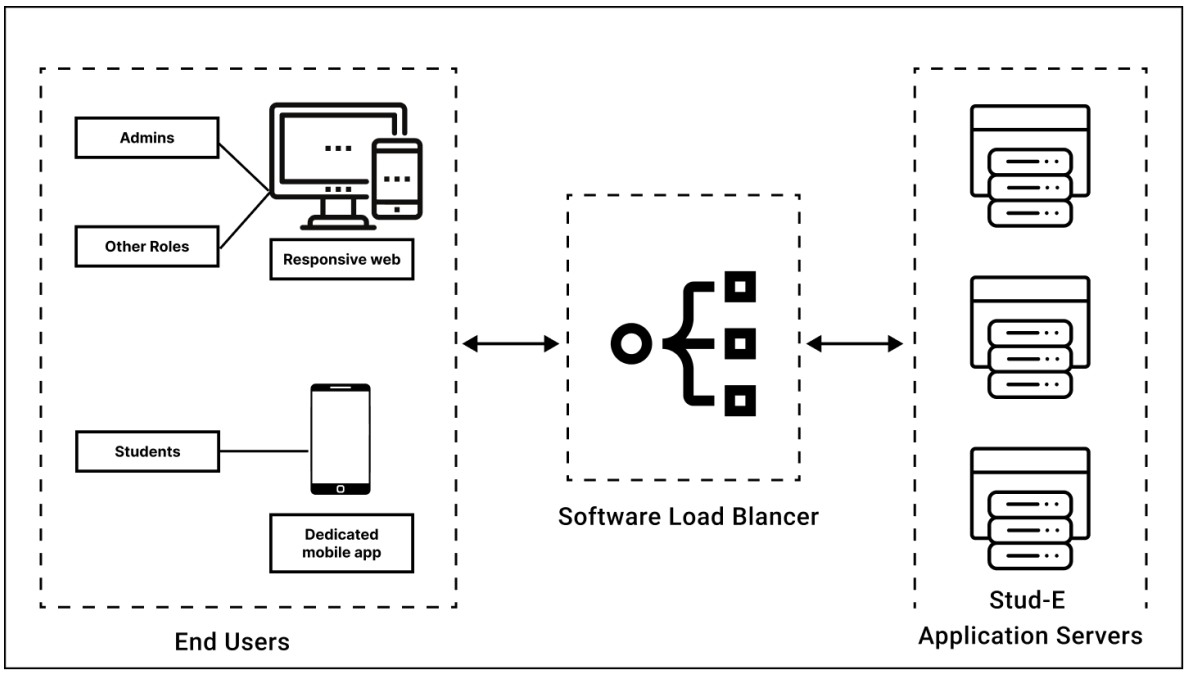

Figure 5.4: Load Balancing diagram

Distributed systems have certain distributed design patterns that fit into one of three types depending on the functionality they operate with which are Object communication[17], Security[18], and Event-driven[19].

There are 5 types of distributed system design patterns CQRS[20], 2PC[21], Saga, RLBS[22], and Sharded Services. our System Stud-E includes Sharded Services. So in the next sub-Section subsection 5.4.4, we are introducing the Sharded Services design pattern.

5.4.4 Sharded Services

An alternative to replica-based designs is to construct a variety of services that each only completes a given sort of request. This is termed "sharding" because you break the request

[15] Ensures high availability and reliability by sending requests only to servers that are online
[16] Provides the flexibility to add or subtract servers as demand dictates
[17] Describes the messaging protocols and permissions for different components of the system to communicate.
[18] Handles confidentiality, integrity, and availability concerns to ensure the system is secure from unauthorized access.
[19] Patterns that describe the production, detection, consumption, and response to system events.
[20] Command and Query Responsibility Segregation
[21] Two-Phase Commit
[22] Replicated Load-Balanced Services

flow into numerous uneven sections. For example, you may have one shard service that takes all cache requests and another that exclusively handles high-priority queries. The load balancer assesses each request when it comes in and distributes it to the appropriate shard for completion.

Sharded services are generally used for constructing stateful services since the amount of the state is sometimes too vast for a single stateless container. Sharding enables you scale the individual shard to suit the size of the state. Sharded services can help you to process high-priority queries quicker. Shards devoted to high-priority requests are always ready to fulfill such requests the instant they come in rather than being put in the queue.

5.5 Conclusion

In this chapter 5, we presented a distributed system for Stud-E. we saw how to distribute our database to numerous MySQL servers and also how to Replicate databases to disperse our servers we mentiond the roles of reverse proxy. Finally, we present the Sharded Services design pattern.

6 | Implementation and Deployment

6.1 Introduction

After we had talked about the Stud-E System Design, and the transition from a single system to a System Distributed, we will move to the final phase of our graduation project, this phase will discuss the big and the subtitles of how we had implemented these models and how we deployed our system.

The implementation of Stud-E requires a number of technology and development tools. We have chosen them on the basis of their characteristics that we deem suitable to meet our needs.

We will see our work environment, the software, and IDE's we used then we move to the languages, frameworks, and database systems, and finally, we will wrap up this chapter 6 by presenting the main interfaces of the different users of our application.

6.2 Implementation

6.2.1 Introduction

When developing a program, the choice of technologies is highly vital insofar as the best appropriate technologies to our objectives must be utilized.

In this section, we will examine the development environment employed in the execution of this project and the collection of processes and tools that are used to build the source code for the software product. Finally, we will present some of the results we obtained.

6.2.2 Stud-E Platforms

Throughout our Stud-E System, we developed essentially 4 applications that communicate with one other to deliver the stated functionality and capabilities to the users.

6.2.2.1 Server-Side Software

This is the main and the core component in our system, it interacts with the client-side[1] throughout RESTful requests, and it has all the security measures required to provide a highly secure environment to Stud-E users.

6.2.2.2 Student-Side Software

We have also implemented a dedicated mobile application that responds to the needs of the students and the process of Stud-E, all the assignments and activities of a student will be via this application.

6.2.2.3 Administrator-Side Software

We have also implemented an Admin panel[2], It exists in order to give administrators control over the Stud-E. In Administrator-Side Software, Administrators can add and ban additional roles in Stud-E such as Scout, Tutor, Expert, and Student furthermore they can approve the initial path[3] of Stud-E and can accept or reject changes made by users, and lastly, they can manage the passage from the initial path to the main path.

6.2.2.4 Supervisor-Side Software

We have developed a Supervisor-Side Software for Role[4] which is a responsive website, which provides Role access to the team they are working with such as output consultation, hangouts, quests, and feed sharing, this website will help roles to access teams' data but each role has limited access to data.

6.2.3 Software Environment (Tools and Technologies)

6.2.3.1 Server-Side

- **Mode WSGI.** application server or mod_wsgi is a WSGI server integrated with the Apache httpd server. The modern mod_wsgi-express command makes it easy to con-

[1] client-side implies other like android application and responsive web for administrators, and supervisors.
[2] The admin panel is an Administrator-Side Software represented by a website.
[3] is the path before starting to enter the main application usually takes 15 days, including creating a team, suggesting a topic that the student wants to work on, or informing the team, specifying the topic of translation that you want to do.
[4] Role are Tutor, Expert, Client, and Scout.

figure and start the server without needing to write Apache httpd configuration. Tightly integrated with Apache httpd. Supports Windows directly.

- **Apach.**[5] Apache is a web server software that is responsible for accepting HTTP requests from visitors and sending them back the requested information in the form of web pages. Without web server software, Stud-E will not work and it directly impacts the performance of Stud-E.

- **Node.JS.** Node.Js Is An Open-Source And Cross-Platform JavaScript Runtime Environment. It Is A Popular Tool For Almost Any Kind Of Project! Node.Js Handle Thousands Of Concurrent Connections With A Single Server Without Introducing The Burden Of Managing Thread Concurrency, Which Could Be A Significant Source Of Bugs. for further information see the docs[6].

- **JWT.**[7] JSON Web Token is an open standard for securely transferring data within parties using a JSON object. JWT is used for stateless authentication mechanisms for users and providers, this means maintaining session is on the client-side instead of storing sessions on the server. in Stud-E, we implemented the JWT authentication system in NodeJs.

- **Crypto** Crypto is a module in Node. js which deals with an algorithm that handles data encryption and decryption. This is used for security reasons like user authentication when keeping the password in Database in the encrypted form. Crypto module contains collection of classes including hash, HMAC, cipher, decode, sign, and verify. for further information see the docs[8]

- **Bcrypt.**[9] Bcrypt is an npm module that simplifies password salting and hashing.

- **Express JS.** [10] Express JS is a Node.js framework designed to construct API's web applications cross-platform mobile apps rapidly and make node js easy.

- **Apache Lucene.**[11] Apache Lucene is a Java library providing powerful indexing and search features, as well as spellchecking, hit highlighting and advanced analysis/tokenization capabilities.

[5] https://www.greengeeks.com/blog/what-is-apache/
[6] https://nodejs.dev/en/learn/
[7] https://www.npmjs.com/package/jsonwebtoken
[8] https://nodejs.org/api/crypto.html
[9] https://www.npmjs.com/package/bcrypt
[10] https://expressjs.com/en/guide/routing.html
[11] https://lucene.apache.org

- **Postman.**[12] Postman is an API platform allowing developers to design, create, test and iterate their APIs. As of April 2022, Postman estimates having more than 20 million registered users and 75,000 open APIs, which it believes forms the world's biggest public API hub.

- **MySQL.**[13] MySQL is a Database Management Systems. It comprises of a data rights defining language as well as a data manipulation language. It has the benefit of being portable (it can be compiled on different systems such (Windows, Unixâ¦ etc.). Moreover, it is straightforward to use, standard (it utilizes SQL), robust, free, and it is completely supported by various computer languages.

- **Redis.** Redis is an in-memory data structure store, used as a distributed, in-memory keyâvalue database, cache and message broker, with optional durability. Redis supports several sorts of abstract data structures, such as strings, lists, maps, sets, sorted sets, HyperLogLogs, bitmaps, streams, and spatial indices. for further information see the docs[14].

- **JavaScript.**[15] JavaScript is a text-based programming language used both on the client-side and server-side that allows you to make web pages interactive. It is lightweight and most commonly, its implementations allow client-side scripts to interact with the user and make dynamic pages. It is an interpreted programming language with object-oriented capabilities.

- **Python.**[16] Python is a high-level, general-purpose, and very popular programming language. Python programming language (latest Python 3) is being used in web development, Machine Learning applications, along with all cutting edge technology in Software Industry. in Stud-E we use python to build deep learning models.

- **TensorFlow.** [17] TensorFlow is a free and open-source software library for machine learning and artificial intelligence. It can be used across a range of tasks but has a particular focus on training and inference of deep neural networks.

[12] https://www.postman.com
[13] https://www.mysql.com/
[14] https://redis.io/
[15] https://javascript.info/
[16] https://www.geeksforgeeks.org/python-programming-language
[17] https://www.tensorflow.org/

- **Visual Studio Code.**[18] Visual Studio Code is Microsoftâs free source-code editor. it includes debugging help, clever code completion, syntax highlighting, code restructuring, and more.
- **Google Colab.**[19] Colab is a free Jupyter notebook environment that operates fully in the cloud. Most significantly, it does not need a setup and the notebooks that you create may be simultaneous - exactly the way you edit pages in Google Docs. Colab supports several common machine learning libraries which may be quickly loaded onto a notebook

6.2.3.2 Student-Side

- **Kotlin.** Kotlin originated at JetBrains, the company behind IntelliJ IDEA, it is a cross-platform, statically typed, general-purpose programming language with type inference. It interoperates extensively with Java, and the JVM version of Kotlinâs standard library relies on the Java Class Library. Still, type inference enables its syntax to be more compact.
- **Java.** Java is a class-based, object-oriented programming language. It is a general-purpose programming language designed to help application developers write once, run everywhere, meaning that generated Java code may run on any systems that accept Java without the need for recompilation.
- **Android Studio.** Android Studio is the standard Integrated Development Environment (IDE) for Googleâs Android operating system, built on JetBrainsâ IntelliJ IDEA software and designed specifically for Android development. We used this software to develop and debug the Android application in our system.

6.2.3.3 Supervisor-Side and Administrator-Side

- **ReactJS.** [20] React is a declarative, efficient, and flexible JavaScript library for building user interfaces. ReactJS is an open-source, component-based front-end library responsible only for the view layer of the application. It is maintained by Facebook.
- **NextJS.** Next.js is a react based framework. It has powers to Develop beautiful Web application for different platform like Windows, Linux and mac.

[18] https://code.visualstudio.com
[19] https://colab.research.google.com/
[20] www.geeksforgeeks.org/reactjs-tutorials

6.2.3.4 Design

- **Figma.** Figma is a web-based graphics editing and user interface design app. You can use it to do all kinds of graphic design work from wireframing websites, designing mobile app interfaces, prototyping designs, and everything in between. We used this software to design UX for Stud-E and design sequence diagrams.
- **Adobe Illustrator.** Adobe Illustrator is a vector graphics editor and design program developed and marketed by Adobe Inc. We used this software to design the Stud-E logo.
- **StarUML.** StarUML is a software engineering tool for system modeling using the Unified Modeling Language, as well as Systems Modeling Language, and classical modeling notations.

6.2.3.5 Other Softwares

- **Git.**[21] Git is free and open source software for distributed version control: recording changes in any set of files, mainly used for coordinating work among programmers collaboratively developing source code during software development. We used this software to record changes in any set of files, and coordinate work among us collaboratively
- **Overleaf.**[22] Overleaf is a collaborative cloud-based LaTeX editor used for writing, editing, and publishing scientific documents. It partners with a wide range of scientific publishers to provide official journal LaTeX templates and direct submission links.Google Docs is an online word processor included as part of the free, web-based Google Docs Editors suite offered by Google,
- **Google Docs.** Google Docs is an online word processor featured as part of the free, web-based Google Docs Editors package given by Google, We utilized this software to produce simple chapters and write article reviews.
- **Google Drive.** Google Drive is a file storage and synchronization service developed by Google. Google Drive allows users to store files in the cloud, synchronize files across devices, and share files. We utilized this software to manage folders and files and to share our work with our graduation supervisor.

[21] https://git-scm.com/
[22] https://www.overleaf.com/

6.2.4 Material Environment

Properties	PC Laptop 1	PC Laptop 2	PC Laptop 3	Mobile
Brand	2020 Apple MacBook Pro	Hp EliteBook 820 G3	Toshiba Satellite C660-162	Samsung Galaxy S8 Edge
OS	macOS Big Sur V11.1	Windows 11 Pro	Ubuntu 20.04	Android 9.0
Processor	i7-1068G7	i7-6600U	i3-380M	Snapdragon 835
RAM	16GB	8GB	6GB	4GB
Screen	13"	13"	15"	5.8"
ROM	1TO SSD	256GB SSD	512GB HDD	64GB

6.2.5 Results and used algorithms

In this sub-section 6.2.5, we present you with numerous implementations of algorithms that we have worked on such as 1) holding role, and 2) storing JSON in a Database. Also a deep learning project for Stud-E classification topics, and results obtained from the BERT model.

6.2.5.1 Hold Role

Figure 6.1 and Figure 6.2 show the source code for the hold roles algorithm:

```
// Adding roles
let rolesTypes={client : 0, expertAi:1, expertDs:2, expertSe:3, expertNt:4,}
let userRoles;
for(var i=0; i<rolesTypes.length; i++){
  userRoles= userRoles|(i<<rolesTypes[i])
}
mysql.update(userRikes,where={userId: 4234})
```

Figure 6.1: Adding roles implementation

```
// Extract roles

let userRoles = mysql.fetch('userRoles',where={userId : 4234}) ;

let count  = Math.log4(userRoles)

let rolesTypes = Array(count)

for(var i = 0 ; i < count; i++) {

    rolesTypes[i] = 0xFFFF | (  userRoles >> i )
}

```

Figure 6.2: Extracting roles implementation

6.2.5.2 How storing JSON in Database

Figure 6.3 show the source code for How to convert JSON TO String and store it in database.

```

module.exports = {

    stringifiedUserJson : function(json) {
        return `{


            \"${global.dbConfig.userSchema.matId}\": ${  json.matId !== undefined ?  json.matId : `null`},
            \"${global.dbConfig.userSchema.brief}\": ${  json.brief !== undefined ?  "\""+ json.brief + "\"" : `null`},
            \"${global.dbConfig.userSchema.userName}\": ${  json.userName !== undefined ? "\""+ json.userName+"\"" : `null`},
            \"${global.dbConfig.userSchema.fullName}\": ${  json.fullName !== undefined ? "\""+ json.fullName+"\"" : `null`},
            \"${global.dbConfig.userSchema.linkedIn}\": ${  json.linkedIn !== undefined ?  "\""+ json.linkedIn +"\"" : `null`},
            \"${global.dbConfig.userSchema.gitHub}\": ${  json.gitHub !== undefined ?   "\""+ json.gitHub+ "\"" : `null`},
            \"${global.dbConfig.userSchema.twitter}\": ${  json.twitter !== undefined ? "\""+ json.twitter + "\"": `null`},
            \"${global.dbConfig.userSchema.skills}\": ${  json.skills !== undefined ?  "\""+ json.skills + "\"" : `[]`},
            \"${global.dbConfig.userSchema.speciality}\": ${  json.speciality !== undefined ?  "\""+json.speciality +"\"" : `null`},
            \"${global.dbConfig.userSchema.likesCount}\": ${  json.likesCount !== undefined ?  json.likesCount : 0},
            \"${global.dbConfig.userSchema.impact}\": ${  json.impact !== undefined ?  json.impact : 0},
            \"${global.dbConfig.userSchema.postsCount}\": ${  json.postsCount !== undefined ?  json.postsCount :  0 },
            \"${global.dbConfig.userSchema.studentOfMonthCount}\": ${  json.studentOfMonthCount !== undefined ?  json.studentOfMonthCount : 0},
            \"${global.dbConfig.userSchema.replyCount}\": ${  json.repliesCount !== undefined ?

                }`
    },
    }

```

Figure 6.3: JSON TO String and store it in database

6.2.5.3 Classification Topics model result

Figure 6.4 show the model Loss and Validation Accuracy, Code source[23].

[23] https://github.com/HowkMii/Stud-E-Topics-Classification-BERT

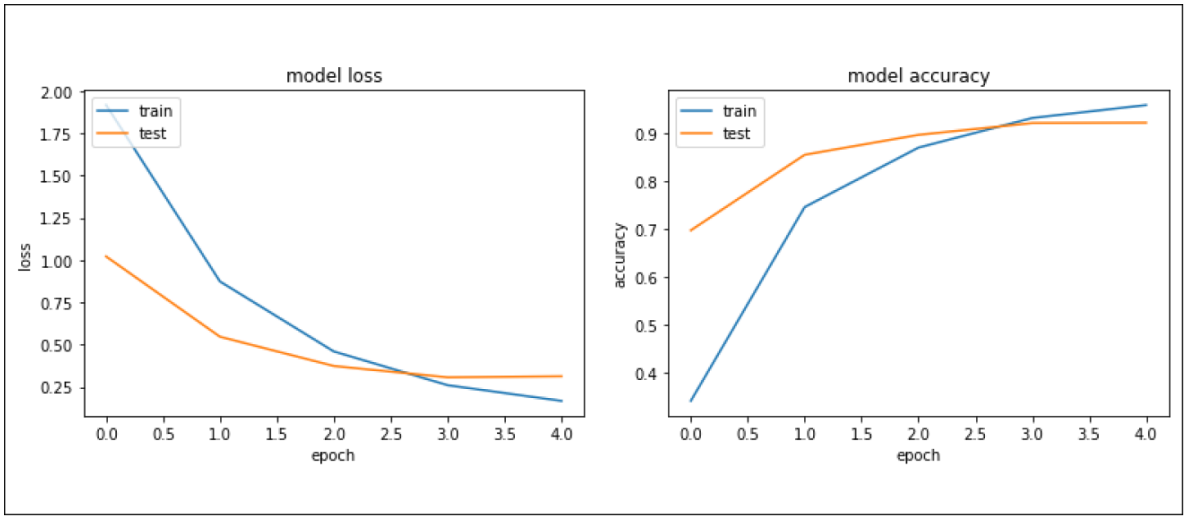

Figure 6.4: Model loss and accuracy

6.3 Software Deployment

6.3.1 Introduction

Software deployment is the process of making software available for use on a system by users and other programs is known as software deployment. You could deploy software to make a backup copy of the software or to move it to another system[24], Software deployment can be thought of as a process consisting of several interconnected activities, including the release of software at the end of the development cycle(Dearle, 2007).

The process of deployment could be hard to implement for distributed systems such as Stud-E because it would be hard to maintain several servers up and working correctly.

In this section we would introduce an overview of our simple solution for Stud-E and all tools that are used in.

6.3.2 Deploying StudE

In order to simplify let suppose Stud-E as not-distributed system in this case it would only requires 3 servers with ubuntu OS and with 1GB RAM and minimum of 10GB storage, one for MySQL and the second for Redis and the last for our Stud-E services which are just node js applications.

[24] https://www.ibm.com/docs/en/zos/2.4.0?topic=task-deploying-software

1. **Configuring MySQL server:** The first step is install mysql using apt as shown below Figure 6.5.

```
$> Sudo apt update
$> Sudo apt install mysql-server
```

Figure 6.5: Setting up MySQL Server

The second step is optional: reconfiguring the MySQL server by typing "sudo mysql secure installation" to add a user to the database, change passwords, and so on. Following that, we must create a Stud-E database, upload its schema file to the server, and import it as shown below Figure 6.6.

```
$> Sudo mysql -u root -p

    Enter password:
    mysql> CREATE DATABASE Stud-E;
    mysql> exit;
$> mysql -u root -p Stud-E /tmp/stud-e.sql
```

Figure 6.6: Setting up Stud-E Database

2. **Configuring Redis server:** The same as before firstly install redis as shown below Figure 6.7. To add/change/remove users or their passwords or anything related to the authentication of redis server just visit documentations[25].

[25] https://redis.io/commands/auth/

```
$> Sudo apt install-release
$> curl -fsSl https://packages.redis.io/gpg | sudo gpg --
dearmor -o /usr/share/keyrings/redis-archive-keyring.gpg

echo "deb [signed-by=/usr/share/keyrings/redis-archive-
keyring.gpg] http://packages.redis.io/deb $(lsb_release -cs)
main" | sudo tee /etc/apt/sources.list.d/redis.list

$> Sudo apt-get install redis'
```

Figure 6.7: Setting up Redis server

3. **Configuring Stud-E services server:** Installing NodeJs Runtime then Apache2 as web server for our services, To get the installation script for the Node.js archives, use curl tool as shown below Figure 6.8:

```
$> curl -sL http://deb.nodesource.com/setup_16.x -o
nodesource_setup.sh
$> sudo bash nodesource_setup.sh 1 #to add to local packages
$> sudo apt-get install nodejs
$> sudo apt-get install build-essential #required to some
packages npm
$> sudo apt apache2
```

Figure 6.8: Setting up NodeJS environment runtime and apache web server

6.3.3 Linking NodeJS apps (Stud-E services) with apache2

The final step is linking NodeJS apps (Stud-E services) with apache2 i.e:

1. Moving services source-code directories into /var/www directory.

2. Create .conf for each service in /etc/apache2/sites-available/ i.e shown in Figure 6.9:

```
communicator.conf

<VirtualHost *:80>
    ServerName 41.73.65.145 # ip address of the current
server

    # Tell Apache and Passenger where your app's code
directory is
    DocumentRoot /stud-e-communicator-service/public
    PassengerAppRoot /stud-e-communicator-service

    PassengerAppType node
    PassengerStartupFile index.js

    # Relax Apache security settings
    <Directory /stud-e-communicator-service/public>
      Allow from all
      Options -MultiViews
      # Uncomment this if you're on Apache >= 2.4:
      #Require all granted
    </Directory>
</VirtualHost>
```

Figure 6.9: Setting conf file for service

then type in the terminal Figure 6.10:

```
$> a2ensite communicator # do the same with other services
```

Figure 6.10: Command Line: Enabling NodeJS application using apache

3. open .env file in the source code file of each service and change the host, username and password of mysql server and redis server. then type in the terminal Figure 6.11:

```
$> service restart apache2
```

Figure 6.11: Command line service restart

6.4 Conclusion

In this chapter, we have described the implementation of a beta version of our Stud-E System. We first detailed the various technologies utilized for the implementation as well as the development environment. We have decided for selections of tools and approaches that are frequently used today in the Server-Side, Student-Side, Supervisor-Side, and Administrator-Side with the material environment, and lastly, we have demonstrated the Bert model results and some algorithms we built.

7 | General Conclusion and Future Work

7.1 Introduction

This general conclusion concludes the research thesis. It begins with providing a summary of the entire research, which recapped all the thesis chapters. This is followed by a list of guiding principles for researchers and practitioners interested in PjBL and crowdsourcing contexts. This general conclusion concludes with a discussion of the future work directions.

7.2 Conclusion of the thesis

In this thesis, we researched PjBL issues and the reasons behind their existence to date. Based on this, we developed a new Stud-E approach that combines MRP2.0 method with crowdsourcing for education.

To facilitate the discussion, we reviewed the relevant literature and industrial practices in the field of PjBL and the MRP method, we offered an insight into how PjBL is engaged in learning also we covered what authors presented the MRP method a new PjBL Method for STEM (chapter 1). Hence, we highlighted MRP needs and ask some questions about how can be realizable in the Algerian mentality. Emphasis was given to existing approaches for each generation to create an appropriate tool, after which we uncovered real-world concerns that drive students to apply a socio-cognitive model of students' motivational dynamics. As a result of this chapter, we introduced MRP2.0 which the extended of MRP (chapter 2). Based on what we have shown, MRP2.0 needs stronger, both in interaction and motivation. as result we introduced a new approach Stud-E. Stud-E is an extension of MRP 2.0 enhanced by crowdsourcing for education, we offered supporting literature to facilitate the mass outsourcing of PjBL and collective intelligence, available in global initiatives and social networks that openly reflect solutions and trends (chapter 3). After we introduced the new approach, it was important to apply it, thus we suggested an integrated system for Stud-E. We began by offering a System Design (chapter 4).

After designing a system,Â first difficulty was that Stud-E is one of its components, being a social networking, in addition, it brings together numerous associated universities. In addition, the system has a hurdle, which is enormous data. As a solution, we presented the distributed system as a big data structure(chapter 5). What we said earlier we implemented(chapter 6).

The work done is aimed at trying to motivate students with PjBL as a research case, MRP is suitable for this but it is method heavy and still not achievable. As a result, we introduced Stud-E, a new approach that contains MRP2.0 requirements that are an extension of MRP, enhanced by crowdsourcing for education.

7.3 Guiding principles for researchers interested in PjBL and crowdsourcing contests

From a practical perspective, our research allows us to offer in-depth guidance to researchers and practitioners interested in using PjBL and Crowdsourcing for education in their work that should be considered in order to design effective solutions.

- **Assignment complexity level:** It is required to specify the assignment complexity level and the projected execution length together with the task requirements when designing the assignment. This will ease the assignment selection process for Student and help them determine whether they can accomplish certain jobs early before they are performed, reach a high level of performance, and acquire the necessary outcomes.
- **Problem reporting mechanism:** It is vital to assess the convenience of use of the reporting mechanism utilized and the time and effort needed to complete the assignment procedure. The fact that this demands more time and more work will surely impair students' desire to make progress on assignments. It is advised that the automated service also be provided to encourage students to submit data or interact with an assistant (chatbot) that would assure better progress in the project and boost students' confidence in themselves.
- **Providing feedback:** Students, Supervisors, and universities must provide feedback and activity summaries to the PjBL and the crowdsourcing for education in textual form i.e "How many times did you attempt to get involved with a project-related task that was outside your immediate responsibility?". This will help them obtain more insight into

how effectively they are performing, which enhances their performance, provides them with a sense of achievement, and motivates them to get more skills.

- **Confidence and motivation:** It is vital to understand the criteria associated to the work setting to produce a meaningful reward schema that can identify a convincing and fair reward value. It is also crucial to build a crowdsourcing strategy with the students in mind, This will boost their faith in the payment value and push them more to accomplish better testing jobs. Different non-monetary incentives also need to be utilized to encourage students; this is important for producing high-quality outcomes for a long period.
- **Communication and interaction:** crowdsourcing universities should always be keen to increase direct communication and interaction between the students. This will enable peers to obtain a deeper knowledge of the PjBLâs criteria and conduct more effective learning rapidly.

7.4 Perspective and future work

The research carried out in this thesis is split into two parts: (1) enhancing project-based learning through crowdsourcing for education, and (2) computer assisting to realizable project-based learning through crowdsourcing.

Regarding the first part, for considerations of time and system availability Our study result has not been evaluated. Following this thesis, our perspectives focus towards the construction of samples that will make it feasible to test our Stud-E approach on a broader scal. In our Stud-E approach, it is about learning approaches and peers and connecting the educational side with the businesses side. Focusing on the individual and collaborative element, we foresee as a research viewpoint that our system is collaborative/individual, meaning that students may seek help from their peers about their learning and/or acquisition of information. Another important feature that we aim to add into the Stud-E project is the component of crowdsourcing and that is the systematic feedback. This is what concerns the theoretical aspect. Any barriers or problems will arise after the experiment. also the Stud-E approach as an extended approach of the MRP method also has its obstacles, the most prominent of which is that it is difficult to prepare and analyze properly. It would be interesting, from a research standpoint, to build a peer evaluation system to encourage a better assignment of work among student teams.

Regarding the second part, IT assistance for the effective deployment of the MRP method is crucial. Therefore, the Stud-E approach arose as a development of the MRP method and provided a new philosophy on the fifth principle of open communication and content management. To obtain such support, we've changed a generic Moodle-based plugin-based approach. Stud-E is a system that combines MRP2.0 with crowdsourcing for education. Students and supervisors are at a higher level of awareness of actual needs. In Stud-E, this evolved into a higher education social networking system. With an integrated system that consists of it, it must be recognized that such a solution allows for greater abilities on the part of the developers of the system represented by us. Due to time we lost out on finishing it altogether. Lack of time The research aspect took a lot of time and energy from us, but we did what was necessary. Only a few easy elements remained from our work.

During development, we concentrated on the core features of the project, and came up with suggestions that might further enhance the application by completing additional user studies and adding more functionality to it. Future applications may include responsive web for students, iOS platform for students and supervisors and others. we will design a deep learning model for recognizing student failure or success, we will develop a conversation network between students with peers, and offer the opportunity to add an interested individual from peer subjects, which may be quite similar to the follow-up feature in the social networks. Finally, we will generate an enhanced version depending on user feedback.

7.5 Conclusion

This thesis is part of a multidisciplinary study on the subject of educational engineering. It is an open and challenging issue and continually developing, particularly with reference to information and communication technologies and notably the Internet. Our research enabled us to be interested in numerous subjects, particularly humanities, social sciences, psychology, software engineering, and project management.

Our work still needs a lot of refining to achieve the best level of performance and availability. Since we were limited by the time and available resources, what we did not accomplish was as follows: CRUD operations, supervisor-side, Administrator-side, and Distributed System Deployment.

As a Stud-E experiment, we've offered a rudimentary version of Stud-E in the Google Solutions Challenge[1], whose 2022 Solutions Challenge goal is to address one or more of the United Nations' 17[2] Sustainable Development Goals. More than 200 teams from various institutions and universities competed. We are glad to announce that we were MENA[3] region winners as the Top 3 solutions in MENA from ibn khaldoun university. also the first place in North Africa.

[1] https://developers.google.com/community/gdsc-solution-challenge

[2] The United Nations created 17 Sustainable Development Goals and aimed to achieve them by 2030. All 193 United Nations Member States agreed on these 17 goals to end poverty, ensure prosperity, and protect the planet.

[3] The Middle East and North Africa

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A | Appendix: UX case study and Student guide

UX CASE STUDY

STUDE

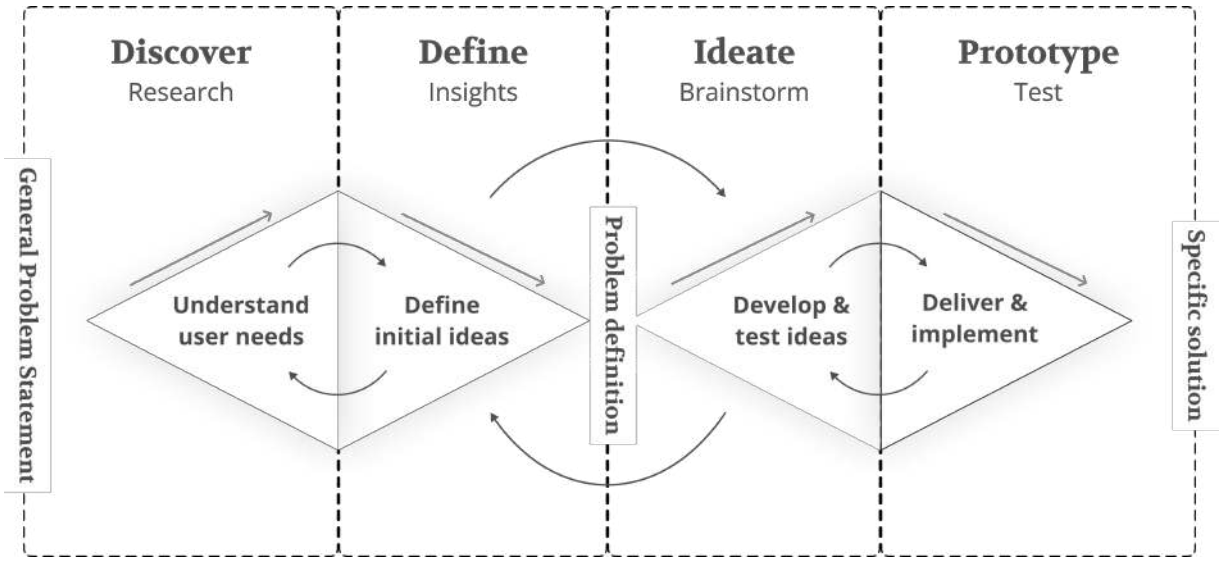
Students Growth together through E-learning

It is no secret that students in Ibn Khaldoun University have been constantly failing and losing interest in completing their studies, we came up with the idea of predicting students with a high rate of Dropping School and trying to motivate them by using IT, The study of our research can be found in the thesis. Now we'll study just the student side in this appendix. This application for students is a social network combined with the MRP2.0 method, which helps students to connect with peers, feel more confident in new surroundings, and solve emerging issues.

TIMELINE	ROLE	TOOLS
December'26 - July'05 (6 Months)	I'm Abdelhakim Azzouz, As a certified Google UX designer, I did these processes in my research: Research, Problem-solving, Ideation, Competitive Audits, Persona, User Flow, Wireframing,Usability Testing & High Fidelity	Figma

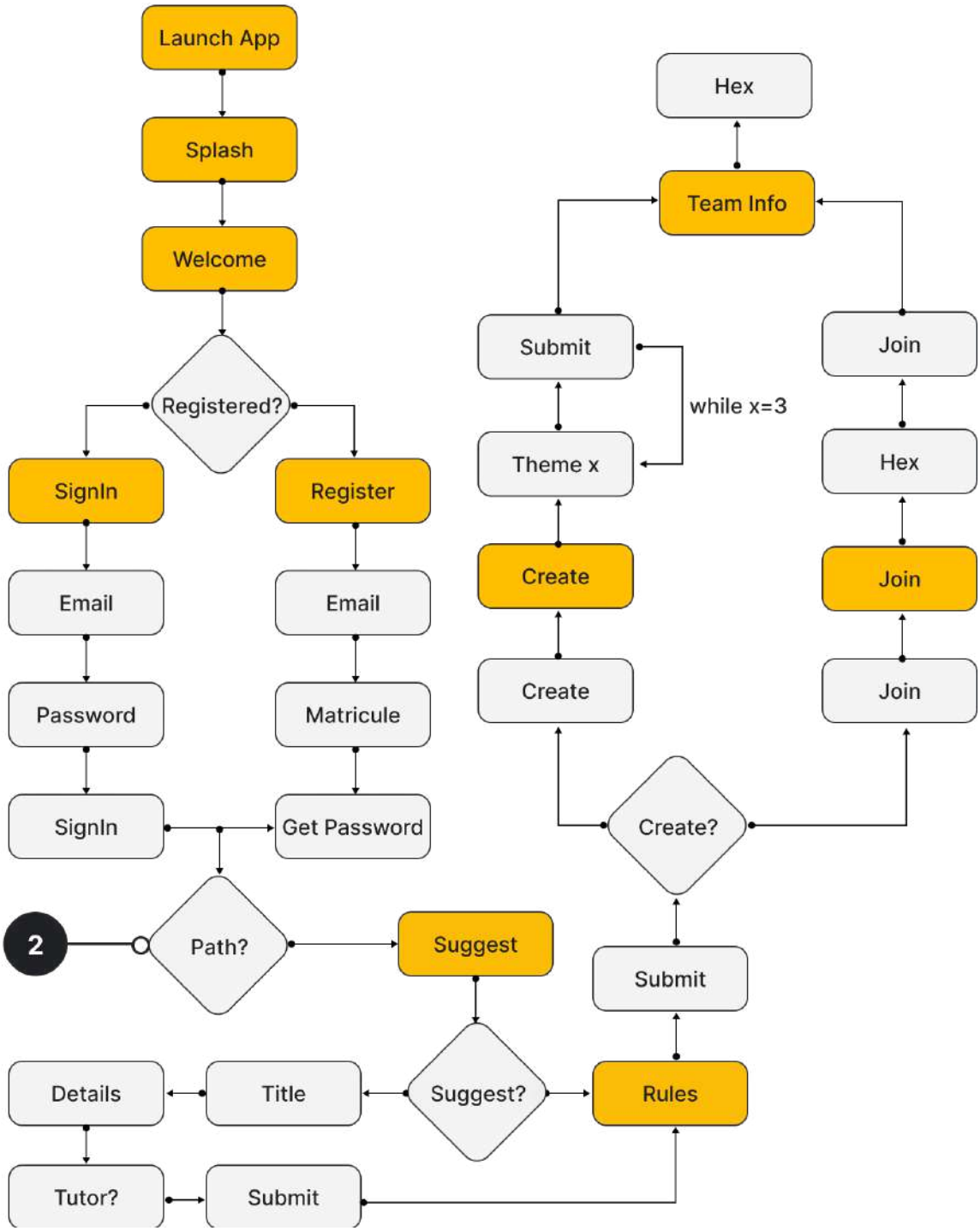
Design Process

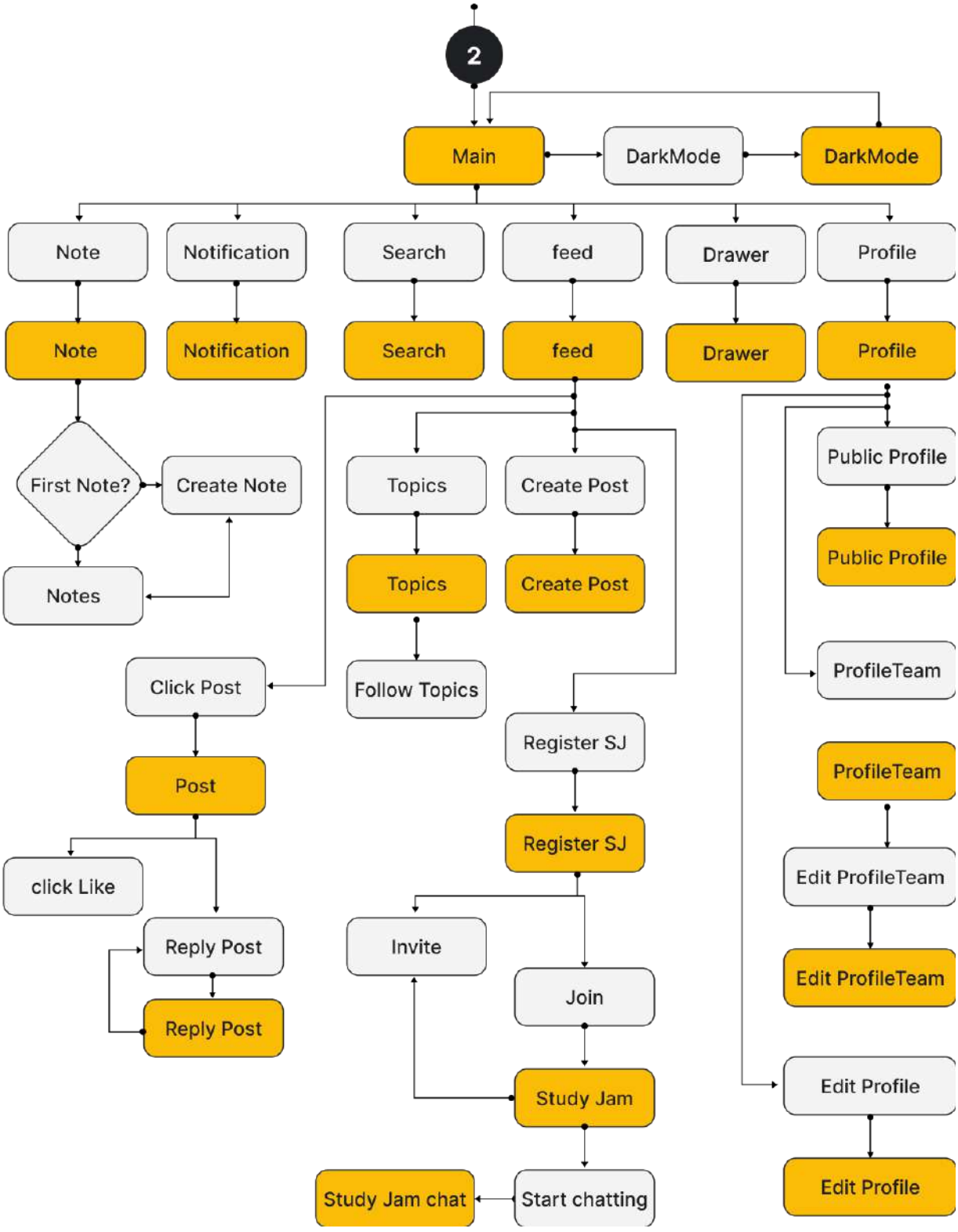
I followed a lean UX design thinking process to ensure that my decision were supported through user research and feedback



User Flow

I laid out potential task flows into one user flow. Here, I thought about different entry points, exit points, and alternate paths.





Note:

This user flow is incomplete We attempted to simplify it for an overview

Student Guide

Splash Screen

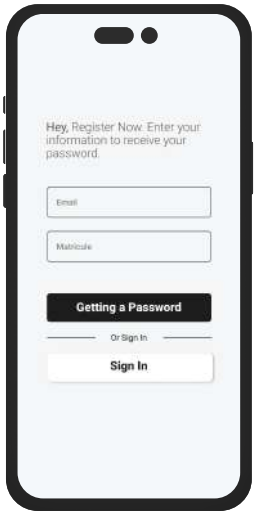
A screen with Stud-E logo and our university's Watermark that sits for 2 seconds as the rest of the application Loads in the Background

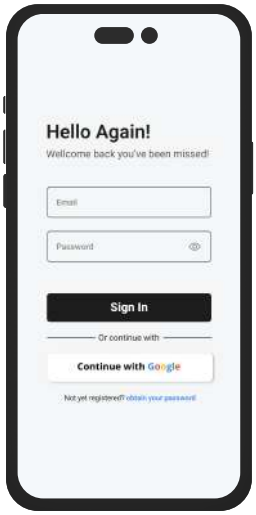
Welcome Screen

A screen with Welcome Svg and two buttons to SignIn and acquire a password which implies submitting the request.

Authentification

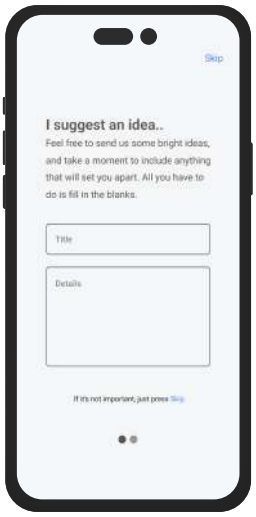
In this side, you have to provide an email and password to be able to go to the remainder of the Stud-E. If you do not have a password, you may sign in with the university email or take the password by request page

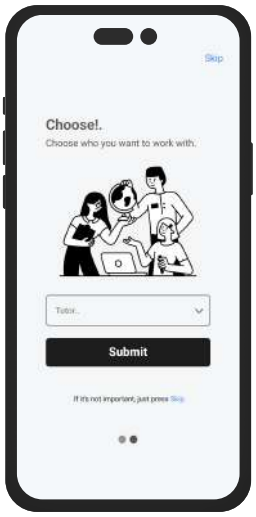


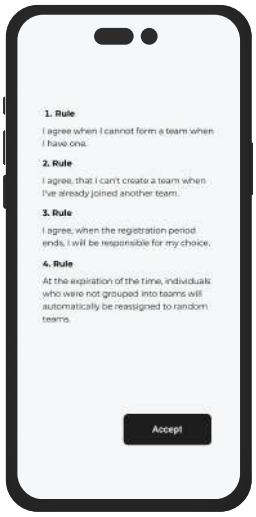


Sugestion Screen

This interface is meant for students who wishes to offer graduation subjects that they want to work on.





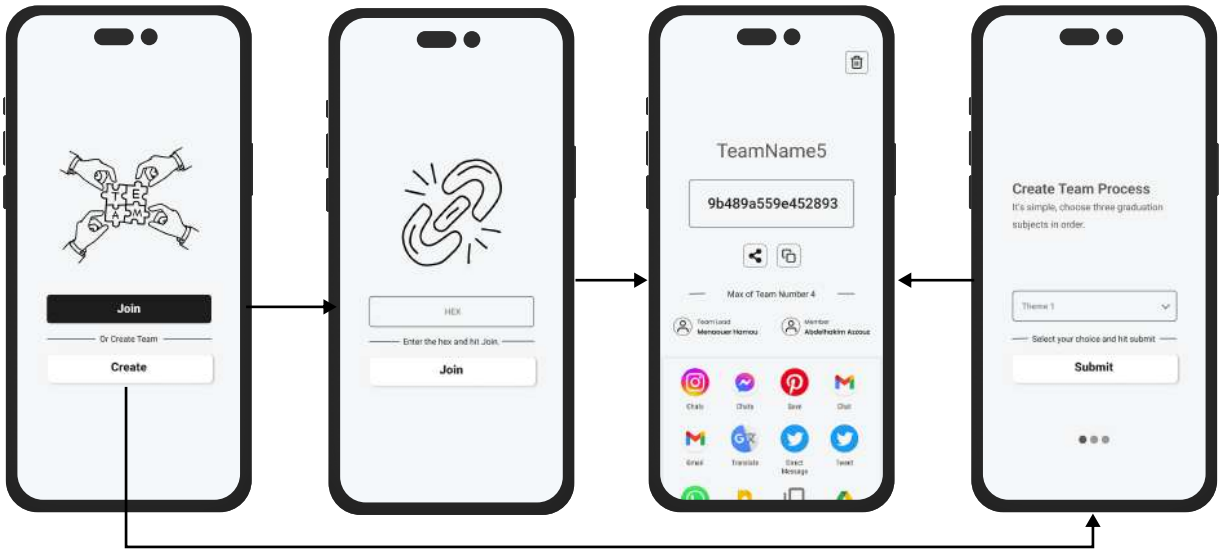


Rule Page

In this side, you have to read and Accept when you agree with rules.

Choice , Join, and Create Team

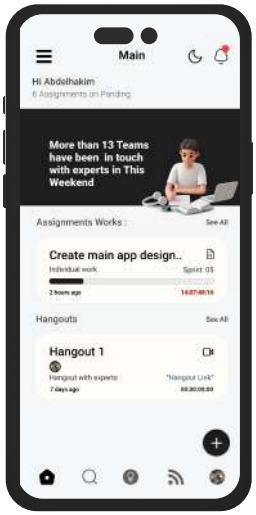
The first choice interface we will select a scenario when you want to join click the join button you will input the order code if it is accurate it will arrange and an interface will appear around the team. You may share the code through social networking sites.

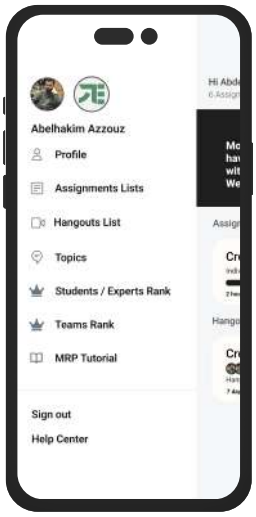


Main Screen

When you open the app, the first screen that appears is this.

1. As you see, the upper bar contains three buttons, first to receive notifications, the second to change the mode to dark last one is a drawer or menu.
2. More than ... here come the motivational phrases we use crowdsourcing.
3. In this part, we see 2 cards one for Assignments and one for hangouts.it will be shown according to the deadline.



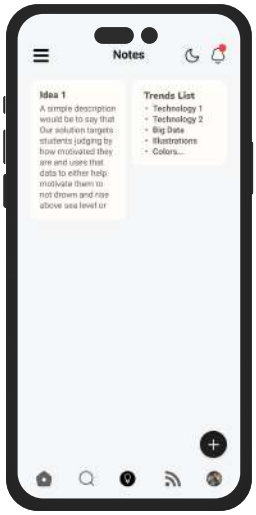


Navigation Drawer

Navigation drawer provide access to the navigation destinations of Stud-E app.

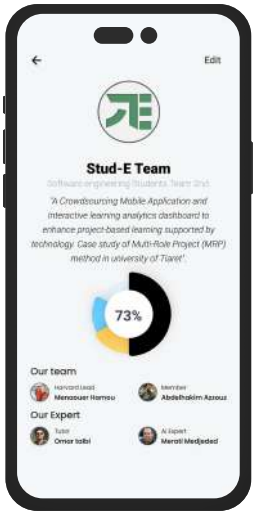
Team Notes

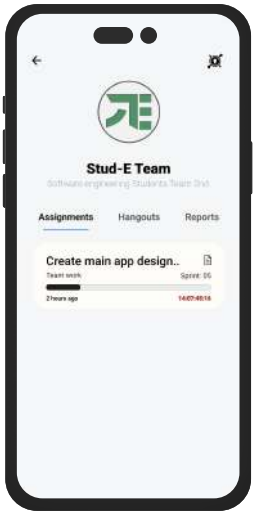
here you may post note about anything (your plan on project , or your thoughts) and share it with the Team.

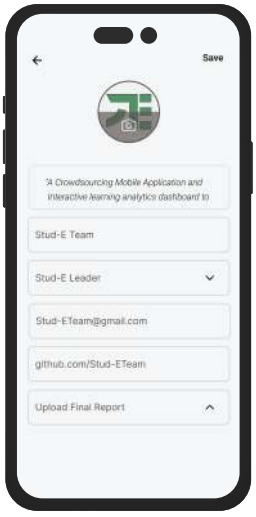


Student Profile and Team Profile

On the profile screen, you can edit your personal information, see your public profile, popularity, months of a student, etc. The same thing applies to team profile





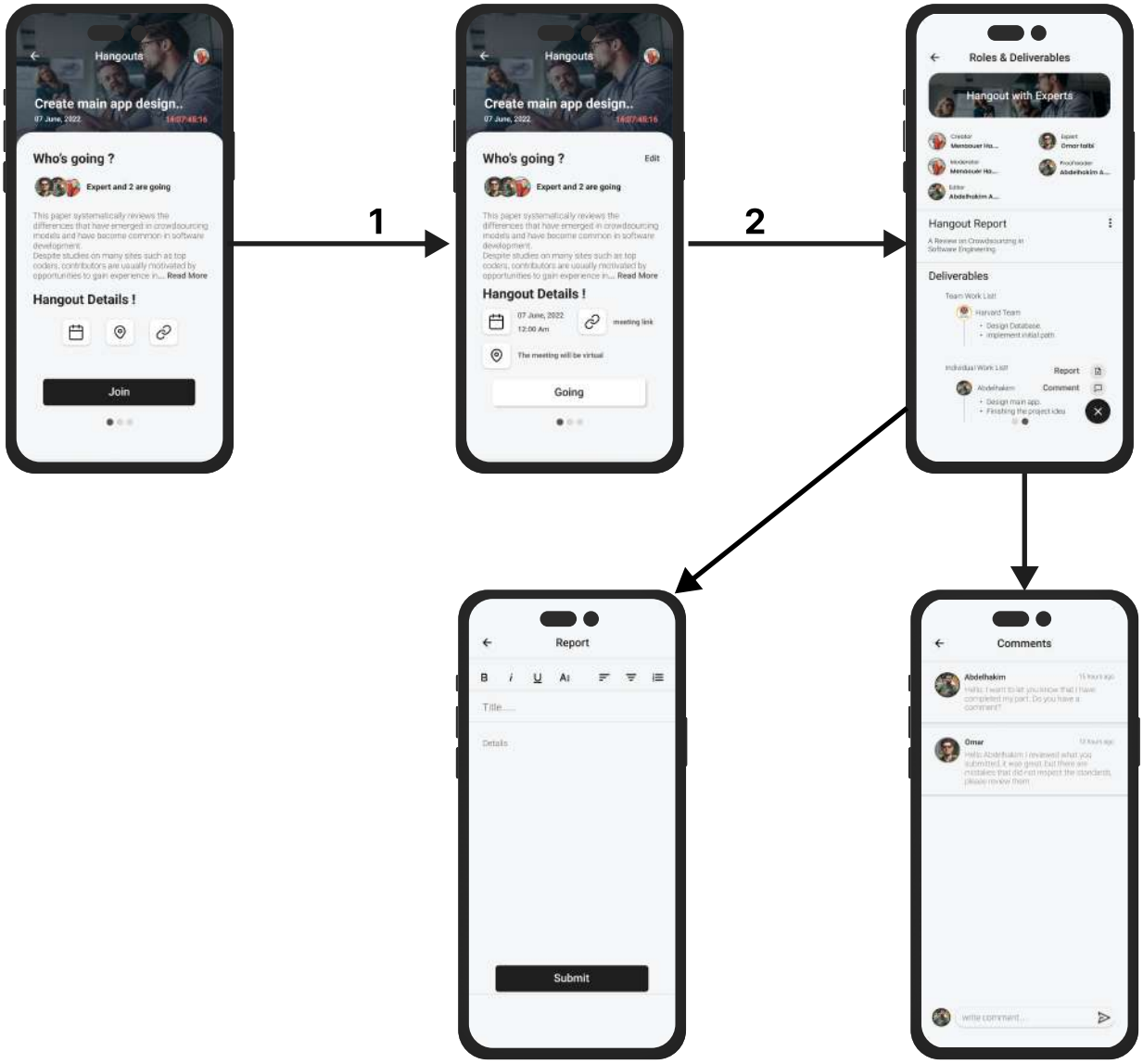


Create Hangout Process

Here is the way to create a hangout simply 1) choose whether it is a hangout with your team or the team with the expert, 2) after entering the address with the details, 3) specify the roles, 4) then the work done individually or collectively, 5) finally you do not have to specify if the hangout is virtual or in attendance with setting the date.

Fetch Hangout

Here you can see all the information of the meeting, the date, who will come, and how much time is left. First, if you wish to attend, click on join. The button you pushed will change. You may write the report from Stud-E editor



Note:

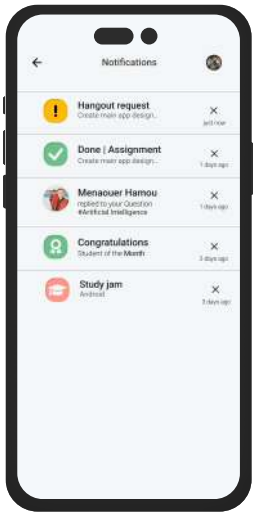
We will not explain how to create an Assignment because our philosophy is taken on simplicity so the same steps for creating a hangout.

Feed

The feed screen here is your space, dear student. You have the freedom to create content. Ask help your peers. How is that 1) You can post any information question. 2) You can reply to your peers' posts. 3) Choose the topics you want, this will help to show more posts about it. 4) Study jam (Crowding)is an event that is limited from time to time for a long time, organized by supervisors with the participation of students with experience in areas in order to answer questions and try to finish large tasks in a short time, you can join by simply pressing the join button.

Notification Screen

Notification screen Here you can review the notifications given There are 5 types of notifications, 1) Notification of hangout, 2) Notification of assignment end, 3) Notification of a reply to your post, 3) Notification that you have been selected as the student of month, 4) Finally Notification of a study group.



Search Screen

Here you can find anything you want. posts, supervisors, teams, students