

UNIVERSITY POLITEHNICA OF BUCHAREST  
FACULTY OF AUTOMATIC CONTROL AND COMPUTERS



# **Encouraging Actionable Feedback from Students Through a Mobile Application**

**Graduate:**

Andrei-Constantin Mirciu

**Thesis supervisors:**

Lecturer, Dr. Vlad Posea

Engr. Ioana Alexandru

Bucharest

2021

---

*Acțiunea de a împărtăși feedback se regăsește în caracterul fiecărui om. În absența unor opinii constructive din partea celorlalți, probabilitatea ca oamenii să își dezvolte abilitățile și să evolueze în carieră scade dramatic.*

*Universitățile oferă adesea oportunități studenților de a-și împărtăși impresiile pe diferite tematici. Cu toate acestea, studenții sunt deseori reticenți sau prea puțin încurajați. În plus, recenziile împărtășite între diferite generații de studenți sunt complet dezorganizate. Prin urmare, această teză explorează motivele care determină, de obicei, studenții să fie dezinteresați de acțiunea de a oferi feedback și se scufundă în înțelegerea nivelului lor de apreciere cu privire la utilitatea acestuia. Mai mult, contribuim la scăderea haosului general, generat de toate opiniile distribuite prin intermediul platformelor de socializare sau chestionarelor neoficiale aleatorii, prin crearea unui mediu cuprinzător.*

*Analizăm situația existentă a feedback-ului în mediul educațional și investigăm nevoile studenților. Pe baza ideilor colectate, propunem o soluție reprezentată de o aplicație mobilă ce utilizează sisteme și instrumente pregătite de utilizat în producție pentru a oferi stabilitate și scalabilitate. Aceasta conține diverse module concepute pentru a spori conștientizarea asupra a ceea ce înseamnă feedback constructiv și oferă ușurință în utilizare, transparență și un set de date structurat.*

*The act of sharing feedback lies in the character of each human. In the absence of constructive opinions from others, the likelihood of people developing their abilities and evolving their careers decreases dramatically.*

*Universities often offer opportunities to their students to share their impressions on different topics. However, students are often reluctant or too little encouraged. In addition, the reviews passed between different generations of students are entirely disorganized. Hence, this thesis explores the reasons that usually prompt students to be disinterested in the action of providing feedback and dives into understanding their level of appreciation on the usefulness of it. Moreover, we contribute to decreasing the overall chaos generated by all the opinions distributed via social media platforms or randomly unofficial questionnaires by creating a comprehensive environment.*

---

*We analyze the existing situation of feedback in the educational environment and investigate the needs of students. Based on the ideas collected, we propose a mobile application solution that uses production-ready systems and tools for offering stability and scalability. It contains various modules designed to broaden the awareness of what constructive feedback means and provide ease of use, transparency, and a structured data set.*

# Contents

<b>List of figures</b>	<b>6</b>
<b>List of tables</b>	<b>8</b>
<b>1 Introduction</b>	<b>9</b>
1.1 Environment . . . . .	9
1.1.1 Team composition . . . . .	10
1.1.2 Innovation Labs . . . . .	11
1.2 Proposed functionalities . . . . .	12
1.3 Outline . . . . .	13
<b>2 State of the Art</b>	<b>14</b>
2.1 Overview . . . . .	14
2.2 Case Study . . . . .	15
2.3 Existing solutions for our university . . . . .	16
2.4 Feedback in pre-university environment . . . . .	19
2.5 Other feedback sharing applications . . . . .	20
2.6 Coronavirus outbreak response . . . . .	21
2.7 Motivation . . . . .	22
<b>3 User study</b>	<b>24</b>
3.1 Methods . . . . .	24
3.2 Target audience . . . . .	25
3.3 Results . . . . .	26
<b>4 UX &amp; UI design</b>	<b>32</b>
4.1 Requirements . . . . .	32
4.2 Feedback questionnaire . . . . .	33

---

4.2.1	Motivation . . . . .	33
4.2.2	Structure . . . . .	34
4.2.3	Chosen questions . . . . .	35
4.3	Prototyping . . . . .	37
4.3.1	Initial design . . . . .	37
4.3.2	Final design . . . . .	39
<b>5</b>	<b>Architecture</b>	<b>42</b>
5.1	Mobile technology . . . . .	42
5.2	Database . . . . .	43
5.2.1	Firestore . . . . .	43
5.2.2	Database structure used . . . . .	43
5.2.3	Remote Config . . . . .	47
5.3	System implementation . . . . .	48
5.3.1	Development process . . . . .	48
5.3.2	Project structure . . . . .	49
5.4	Testing . . . . .	49
<b>6</b>	<b>Conclusion</b>	<b>51</b>
6.1	Results . . . . .	51
6.2	Future improvements . . . . .	53
6.2.1	Gamification . . . . .	53
6.2.2	Filtering . . . . .	53
6.3	Mentorship . . . . .	54
	<b>Abbreviations</b>	<b>55</b>
	<b>Bibliography</b>	<b>56</b>

# List of Figures

1.1	Application contributors according to GitHub . . . . .	10
2.1	Percentage of classes where students completed the feedback questionnaire at the end-of-semester . . . . .	18
2.2	Reasons for not completing the feedback form according to <i>ACS/UPB</i> . . . . .	19
3.1	Distribution of students according to the year of study and specialization . . . . .	25
3.2	Distribution of students who provide feedback or not . . . . .	26
3.3	Platforms and methods used for sharing feedback . . . . .	27
3.4	Reasons why students provide feedback . . . . .	27
3.5	Feedback - anonymous or not? . . . . .	28
3.6	The average time taken to complete a feedback questionnaire . . . . .	29
3.7	Reasons for not providing feedback . . . . .	30
3.8	Interest of students in the opinions of others . . . . .	30
3.9	Overall interest of students in the opinions of others . . . . .	31
3.10	Main points of interest for students . . . . .	31
4.6	Emoticons used by Google Maps Timeline email template . . . . .	37
4.1	Feedback prerequisites mock-up . . . . .	38
4.2	Feedback questionnaire mock-up . . . . .	38
4.3	Vibe check mock-up . . . . .	38
4.4	Opinions page mock-up . . . . .	38
4.5	Statistics overview mock-up . . . . .	38
4.7	Feedback notification on the Home page . . . . .	39
4.8	People page . . . . .	39
4.9	People page search option . . . . .	39

---

4.10	Feedback questionnaire page . . . . .	40
4.11	Feedback checklist page . . . . .	40
4.12	Feedback statistics page . . . . .	40
5.1	Number of operations for our application, as reported by Firestore, in the last 30 days . . . . .	44
5.2	Remote Config parameter values, as shown in the Firebase interface	47
5.3	Condition used to enable feedback, as displayed by Firebase . . . .	48
5.4	The hierarchy of files and folders from our project structure . . . .	49
5.5	Code coverage evolution . . . . .	50
6.1	Active users, according to Firebase, plotted over the last <b>12</b> months	52

# List of Tables

2.1	List of features offered by other similar applications . . . . .	21
5.1	<b>users</b> collection additions . . . . .	44
5.2	<b>forms</b> collection structure . . . . .	45
5.3	<b>class_feedback_questions</b> document structure . . . . .	46
5.4	<b>feedback_question</b> type structure . . . . .	46
5.5	<b>class_feedback_answers</b> collection structure . . . . .	47



# Chapter 1

## Introduction

Nowadays, there are various ways in which people can express their thoughts about different domains such as medicine [1], politics [2], science, or education [3]. Individuals can make their opinions known verbally and in writing through the various platforms or questionnaires provided by public or private institutions, companies, NGOs, or other fellows. Whether we realize it or not, the action of sharing or receiving feedback is part of our daily social life. Since childhood, individuals are accustomed to complaining to their parents when something does not suit their preferences or wishes. Over time, as they mature, people are taught to have their say both in the educational environment and in their professional careers.

### 1.1 Environment

This thesis represents a continuation of a project initiated in 2020, called *Design and Implementation of a Cross-Platform Mobile Application That Facilitates Student Collaboration* [4]. Observing a particular interest from students in this idea, we decided to continue developing this product.

Consequently, we chose to focus on students enrolled at the Faculty of Automatic Control and Computers<sup>1</sup> (henceforth called ACS), **University POLITEHNICA of Bucharest (UPB)**, Romania.

Throughout this section, we present a brief history of the application and how we started working around this idea. Moreover, we describe all the functionalities

---

<sup>1</sup><https://acs.pub.ro/en/home/about-us/>

developed.

Our thesis categorizes a *review* as the action by which students share their opinions to their fellows on the services provided by an educational environment [5]. Contrariwise, the role of *feedback* is to provide insights to a school administration on how to improve its overall operation mode. Thus, although these two terms are pretty similar, their purpose is entirely different. Moreover, these words are not used interchangeably.

### 1.1.1 Team composition

Although it started as a simple personal project, the desire of the founders of this idea pushed them to take everything to a higher level. Wanting to ensure that this application was published in the shortest time possible and realizing that development on their own is far from being effective, it was concluded that a team was necessary.

Starting in July 2020, Ioana Alexandru, the initiator of this project, managed to structure a squad of about six people willing to contribute in their spare time, regardless of the year of study.

Initially, all the participants gathered were trained through a *workshop*<sup>2</sup> about the purpose of this idea and familiarized with the technology used and the structure of the existing codebase. Subsequently, they were proposed diverse directions in which to get involved voluntarily, depending on the preferences and knowledge of each one. Among the aspects proposed, we can identify ideas that involve implementing new features or fixing known bugs & issues, research on User Experience (UX) and User Interface (UI) design, the addition of relevant information into the database, and improving the code testing approach.

Until the beginning of the next academic year in October 2020, this team kept

#### Contributors

- Ioana Alexandru
- Andrei-Constantin Mirciu
- Adrian Mărgineanu
- Alex Conțiu
- Eric Postolache
- Gabriel Gavriluță
- Crăciun Octavian
- Răzvan Rădoi
- George Diaconu
- Maria Stoichițescu
- Anghel Andrei

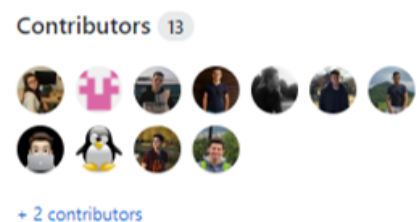


Figure 1.1

<sup>2</sup><https://github.com/student-hub/flutter-workshop>

expanding, all students being united by the same passion, more precisely the development of a handy and straightforward to use, comprehensive product, respecting the slogan *from students, for students*. To maintain an organized structure regarding their progress, they decided to establish a weekly meeting to discuss the contribution of each team member during the previous week and also mention which objectives to focus on next.

The author of the current thesis is part of the team of developers built around this idea. Thereupon, we will use the pronoun *our* to refer to the work environment of this project.

Due to the pandemic context, our communication was based exclusively online, via platforms like *WhatsApp*<sup>3</sup>, *Google Meet*<sup>4</sup>, *Slack*<sup>5</sup>, and *Microsoft Teams*<sup>6</sup>. However, this fact did not represent an impediment to achieving a realistic, friendly, and motivating work environment.

About a year after being created, the team coordinating this project consists of more than ten active developers, and it is still growing (fig. 1.1).

### 1.1.2 Innovation Labs

Encouraged by the positive feedback received, we decided to advertise our idea to the general public from Romania by entering the **Innovation Labs**<sup>7</sup> start-up accelerator program.

Following the discussions with mentors from different areas of the industry, including education, marketing, and engineering, we concluded that it would be appropriate to create an association around this idea, namely **StudentHub**. We are planning to register our identity by the end of July 2021 officially.

Correspondingly, this program facilitated a solid development of the application by constantly providing feedback on our progress and plans. Our team is currently developing a generic *prototype*<sup>8</sup>, which can be used as a skeleton or backbone project to customize one single application concept for different universities in our country, depending on their specific requirements. Therefore, we

---

<sup>3</sup><https://www.whatsapp.com/>

<sup>4</sup><https://meet.google.com/>

<sup>5</sup><https://slack.com/>

<sup>6</sup><https://teams.microsoft.com/>

<sup>7</sup><https://www.innovationlabs.ro/>

<sup>8</sup><https://github.com/student-hub/demo>

permanently consider different architectural solutions to write code in a modular fashion, thus allowing easy decoupling of functionalities or data structures, if needed. Additional details about our architecture are described in chapter 5.

## 1.2 Proposed functionalities

Following the circumstances previously illustrated in section 1.1, the current thesis focuses on understanding the challenges students face daily and their opinion on the relevance of providing feedback for both teachers and their fellows.

We collected and analyzed answers from students through a questionnaire distributed in an online fashion via social networks. We further present its outcome in chapter 3, based on which we come up with ideas for improvement and structure the needs of students into technical specifications.

Moreover, we designed, developed, validated, and integrated multiple modules with an already existing application, namely ACS UPB Mobile<sup>9</sup>:

- people page located in the bottom navigation view, which contains handy and highly sought after contact details of teachers, displayed through a modal bottom sheet
- search bar option that allows finding a specific person directly
- the connection between a lecture and its associated professor when a new event is added to the timetable
- card containing the class name and its corresponding lecturer on the class information page
- feedback form that can be accessed exclusively under certain conditions, mainly concerning specific periods
- a checklist page, which separates the classes depending on whether a student completed or not its matching feedback questionnaire; along with this feature, we created a notification card displaying the total number of reviews that are still pending to be concluded
- a statistics page with all the results gathered from students

---

<sup>9</sup><https://github.com/student-hub/acs-upb-mobile>

Hence, our application provides students transparency and relevant statistics and details about their classes through clear and concise pages. This approach broadens the awareness of students, as well as their overall level of information. Similarly, our features relieve older generations from presenting detailed descriptions about classes at the beginning or over a semester. At the moment, this type of action is time-consuming and takes place in a somewhat disorganized manner.

Our work is sustained by an ecosystem that uses production-ready mechanisms, both in design and architecture, further detailed in chapters 4 and 5. These help us increase our efficiency, consistency, and global quality by offering already predefined graphic elements, core functionalities, and lower operating costs, which are also presented in the previously mentioned chapters.

## 1.3 Outline

**Chapter 2** outlines the current context of the relevance of feedback in the educational system, looking both from our faculty of choice and other universities in conjunction with the pre-university environment in Romania. In the same manner, this chapter describes some concrete examples which support the usefulness of this idea.

**Chapter 3** highlights the methods used to obtain the opinion of students on the topic approached, focusing primarily on the analysis of a study conducted in this regard.

**Chapter 4** presents the stages preceding the beginning of the effective development of proposed functionalities, including prototype defining and the thinking behind the choice of questions from the feedback form.

**Chapter 5** exposes the architecture used, along with the database model. More than that, we indicate our automatic testing methods used to verify that our application is running smoothly.

**Chapter 6** infers all conclusions reached following the analysis of the current thesis, along with ideas worthy of further consideration.

# Chapter 2

## State of the Art

As Bill Gates, a famous American entrepreneur and co-founder of Microsoft Corporation, mentioned at a TED<sup>1</sup> conference in 2013, *"We all need people who will give us feedback. That is how we improve."* [6]. This simple phrase resonates with many of us. Regardless of the field in which a person activates and of their position, the lack of constructive advice decreases their ability to evolve from any perspective.

Despite expressing themselves freely, people tend to be hesitant to share their points of view [7]. This behavior is mainly because individuals often gather truly negative remarks throughout their lives without being offered tips for improvement, thereby completely demotivating them. [8]

We examine the methods of offering and collecting feedback existing so far at ACS/UPB and develop feasible improvement solutions.

### 2.1 Overview

According to Mary Clynes and Sara Raftery, *"feedback represents an indispensable aspect of teaching and learning. People usually categorize terms used to describe feedback into two broad groups: constructive/corrective/negative and reinforcing/positive. In general, however, practitioners tend to use the terms negative or positive when describing feedback."* [9].

Universities often offer opportunities to their students to share their impressions on different topics. These might range from verifying if the general endow-

---

<sup>1</sup><https://www.ted.com/>

ment (more precisely location, hardware, and software support) is adequate for all activities carried out, how well prepared teachers are, and how captivating or challenging a class seems. Of course, besides remarks of the current situation of the educational environment, students are also encouraged to offer recommendations on how to improve the aspects considered as less pleasant or improper.

However, although methods of submitting feedback to teachers are numerous [10], environments through which students can share their thoughts with future generations are limited and inconsistent. Concrete examples for the two previously mentioned categories concerning our university are further described in section 2.3. Therefore, according to Eileen Ruberto [11], instead of having an organized platform or page containing the opinions of students, these are often ending up being shared in a chaotic style. As a result, she deduced that the likelihood that people might omit or lose specific comments or that the information handed over will not reach everyone who might be interested increases substantially.

## 2.2 Case Study

To observe the situation in the Romanian university education system regarding the feedback collection process closely, we interrogated several students from different cities and fields of study.

A fourth-year student at the **Grigore T. Popa University of Medicine and Pharmacy Iasi**<sup>2</sup> that we interviewed mentioned that social platforms, i.e., Facebook or WhatsApp, are the main ways students share reviews about different topics. For instance, students have created private groups with all their fellows. These serve as a place where any student can address an inquiry, and someone else, who has already experienced that, might help him with an opinion or resolution. In addition, he confirmed that this method of sharing feedback is somewhat effective. However, it is time-consuming, given that information is not adequately structured and classified. In terms of providing feedback to teachers, similar to ACS/UPB, he uses the online course platform of his faculty to access a questionnaire at the end of each semester. However, in contrast to ACS/UPB, their survey extends over five weeks, occurring after the exam session. Moreover, the questions asked are primarily focused only on the capabilities of the teacher.

---

<sup>2</sup><https://www.umfiasi.ro/en>

Based on the results obtained from students, the university publishes an official list with the name of each teacher and its general score.

A Master's degree student at the **Technical University of Cluj-Napoca**<sup>3</sup> stated that distributing feedback in their institution is quite similar to the ideas previously listed. Hence, he is also using an online platform to select a specific class and its associated teacher, then being redirected to answer a set of anonymous questions. However, the authentication method represents an exciting aspect. More precisely, each generation of students needs to use a different generated code to login into the platform. Thus, at the end of the feedback period, students have absolutely no visibility on the statistics obtained.

We also interviewed a fourth-year student at the **Faculty of Law**<sup>4</sup> within the **University of Bucharest**<sup>5</sup> (UB), howbeit the conclusion is the same: students cannot access the opinions and feedback submitted by their colleagues. As a result, social networks are located at the top in student collaboration and sharing impressions about different classes.

## 2.3 Existing solutions for our university

Universities have introduced various methods for students to express their reviews on various aspects of the educational process.

Taking the Faculty of Automatic Control and Computers as an example, all possible channels of communication and argumentation of a point of view are:

- the **Moodle**<sup>6</sup> course platform, which offers two possibilities: students can share their thoughts both on a forum dedicated to administrative information (throughout the whole semester) and at the end of a semester, through feedback questionnaires related to each class
- directly to teachers or assistants
- directly to the series guide
- constantly to the Computer Science & Engineering Department, through the

---

<sup>3</sup><https://www.utcluj.ro/en/>

<sup>4</sup><https://drept.unibuc.ro/index-en.htm>

<sup>5</sup><https://unibuc.ro/?lang=en>

<sup>6</sup><https://curs.upb.ro/?lang=en>



**LSAC**<sup>7</sup> (Students League of Faculty of Automatic Control and Computers) association

- regular meetings organized by teachers, in which students express their thoughts about the academic year.

Thus, although there are many means through which students can express themselves to improve the teaching environment, there are no well-defined methods by which a current generation of students can provide a benchmark for future generations.

Reviews passed between different generations of students are entirely disorganized: they share impressions via *Google Docs*<sup>8</sup> or *Google Sheets*<sup>9</sup> files, distributed in groups formed on various social media platforms, like Facebook or WhatsApp. As a result, the risk of a student missing these reviews is enormous, considering situations such as failure to notice an essential post among dozens or hundreds of other messages, not belonging to the groups where feedback documents were published, or even the non-use of such social platforms.

In the current context, in terms of feedback provided to teachers, especially using the Moodle platform, the main disadvantage comes from the fact that the data collection process does not provide transparency. Consequently, students do not know how it is handled, interpreted, and examined, the reason why they might feel their thoughts are not being taken into account.

A study conducted by the **Faculty of Automatic Control and Computers** for two months, from March 2021 to May 2021, confirmed this theory. During this time, **1609** responses from both Bachelor's and Master's students, including all years of study, were collected. Hence, the data set obtained contains various opinions influenced by multiple factors, thus creating an unbiased coverage.

This research revealed that about a third of the total students involved stated that they completed the feedback questionnaire at the end-of-semester, on average, at more than **75%** of their classes, as illustrated in figure 2.1:

---

<sup>7</sup><https://lsacbucuresti.ro/>

<sup>8</sup><https://docs.google.com/>

<sup>9</sup><https://www.google.com/sheets/about/>

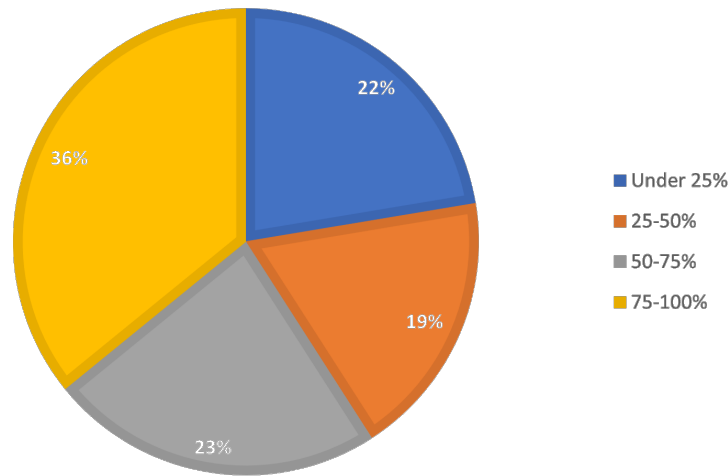


Figure 2.1: Percentage of classes where students completed the feedback questionnaire at the end-of-semester

Asked why they choose not to complete such feedback questionnaires, **41,5%** of the total number of participating students stated they do not believe these seem to impact. In addition, **33,8%** mentioned that if a class is on the same page with their expectations and everything goes well, they prefer not to express their feedback anymore. On the contrary, among the least voted options are ideas that assume feedback is not anonymous or takes too long to complete. This outcome shows that students are confident their privacy is respected and data collected is not associated with a specific profile.

Simultaneously, this study confirmed that the total time required to elaborate answers is not considered an impediment. However, another essential point of particular interest is that approximately **34.5%** of students, being a rather worrying percentage, could identify other reasons (but these were not mentioned) for choosing not to get involved in such activities, as can be observed in figure 2.2:

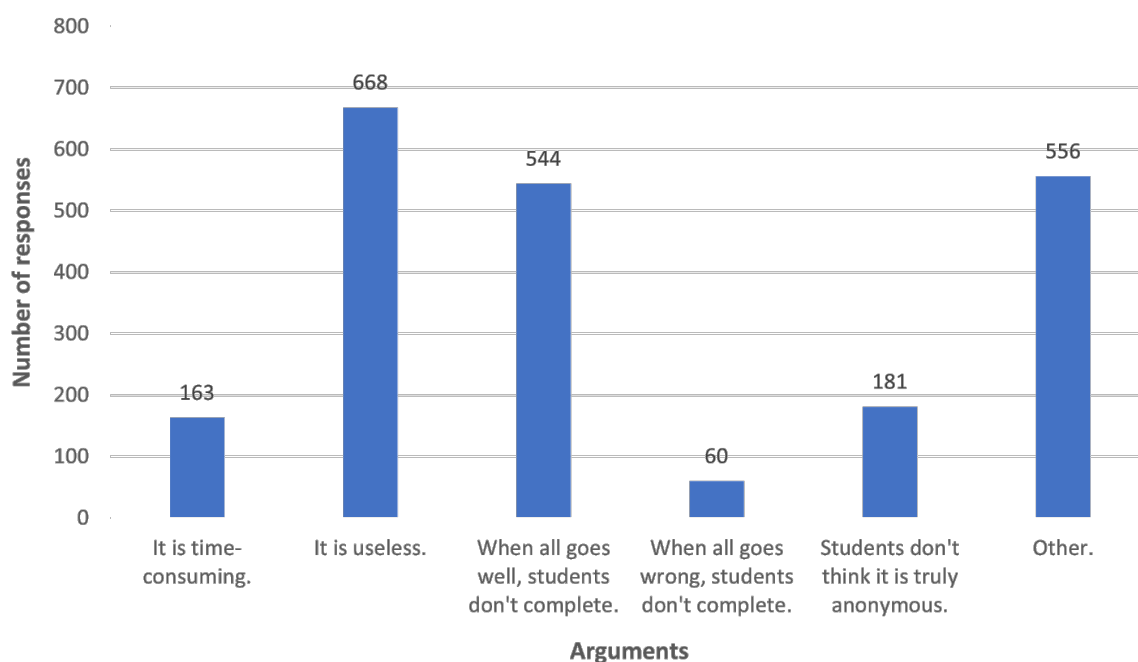


Figure 2.2: Reasons for not completing the feedback form according to ACS/UPB

Consequently, the purpose of this thesis is to outline as well as possible these ambiguities and analyze diversified solutions for their diminution.

## 2.4 Feedback in pre-university environment

In Romania, there is no clear strategy regarding the collection of feedback in the pre-university educational system. Equally, the perception of open communication between school students and teachers, combined with the exchange of mutual feedback, is almost non-existent. As a result, each teacher can maintain such activity only on his initiative since there is no regulation at a national level.

Starting April 2021, under the guidance of the **National School Students Council**, the **Ministry of Education** is working on a methodology involving the evaluation of teachers and the atmosphere in classrooms at the end of each semester, via questionnaires that students can complete both electronically and in printed format. These are announced to be anonymous, and their processing is clearly expressed: data obtained will be used to identify the most effective teaching methods and how students perceive the benefits of education. Moreover, according to **Rares Voicu**, President of the National School Students Council, the

objective of this initiative will be to guide on how the didactic activities take place, thus signaling any dilemmas that should be treated [12]. According to the Ministry of Education, after this law is approved, school students are given a chance to reflect regularly on how school aids them to advance and grow.

In general, questions addressed to school students are highly similar to those intended for students at university, thereby improving the teaching-learning act. However, among the questions underlying this approach, different patterns can be identified: how clearly teachers explain the theory and the exercises, how high the workload is, whether the grading system is adequate or not, whether the overall difficulty is at an appropriate level, and how the teacher stimulates critical thinking.

Therefore, since students are the beneficiaries of the educational system, they are the only ones capable of announcing what their needs, pleasures, and feelings are. The mission of each mentor is to feed the innate curiosity and intrinsic motivation of the students to strengthen their creative thinking and imagination.

## 2.5 Other feedback sharing applications

People have developed various feedback applications over time, thereby craving to promote the free expression of thoughts and the act of offering suggestions.

**Teleskop**<sup>10</sup> is a cross-platform solution, delivered as a web platform or application for Android<sup>11</sup> and iOS<sup>12</sup> operating system smartphones, allowing teachers to receive incognito feedback from students right at the end of each class. According to its founders [13], over 10,000 answers were collected by the beginning of February 2021 from Romania and the Republic of Moldova. The main advantage of this application is that it is straightforward to use for both students and teachers:

- all needed is a device connected to the Internet
- completion time is as short as possible
- students do not need to authenticate

---

<sup>10</sup><https://teleskop.ro/>

<sup>11</sup><https://www.android.com/>

<sup>12</sup><https://www.apple.com/>

- a range of pre-configured forms can be selected directly

Finally, all results are displayed in real-time straight into the account of a teacher, thereby being easy to apprehend.

Furthermore, other tools that also aim to collect results, impressions, and thoughts are **Google Forms**<sup>13</sup> (one of the most used platforms at this moment), **Kahoot**<sup>14</sup> (which offers an interactive and pleasant environment through gamification features), **Socrative**<sup>15</sup> (effective and easy to use application) or **Crowd Signal**<sup>16</sup> (a platform that specializes in creating customized questionnaires and allows the analysis of results).

To get an overview of all the applications previously mentioned, we created a comparative table of features:

Table 2.1: List of features offered by other similar applications

Feature	Teleskop	Google Forms	Kahoot	Socrative	Crowd Signal
Anonymity	✓	✓	✓	✓	✓
Cross-Platform	✓	□	✓	✓	✓
Customizable questions	□	✓	✓	✓	✓
Gamification	□	□	✓	✓	□
Attractive UI	□	□	✓	✓	□
Real-time results	✓	✓	✓	✓	✓

## 2.6 Coronavirus outbreak response

As a result of the pandemic situation generated by the *SARS-CoV-2* virus, most universities in Romania decided to partially or wholly interrupt the physical activity of the classes, thus moving them to the online environment.

Analyzing the environment within ACS/UPB, although this change was quite demanding at first, students have become accustomed to it. Feedback played a crucial role in determining how teachers conduct digital activities. After a

<sup>13</sup><https://www.google.com/forms/about/>

<sup>14</sup><https://kahoot.com/>

<sup>15</sup><https://www.socrative.com/>

<sup>16</sup><https://crowdsignal.com/>

year and a half of strictly supporting actions in a virtual climate, students stated through occasional meetings with the faculty management and coordinating professors that the overall level of tasks and involvement required has increased.

Therefore, students were distressed that specific assessment methods had to be changed. Some classes were initially even forced to introduce more evaluations, thereby verifying knowledge gained. Fortunately, all these opinions were immediately collected and remedied as optimally as possible. In the same manner, teachers tried to offer increased flexibility to students. Thus, students were able to choose the variants most suitable for them. The final evaluation for some classes represents a clear example in this regard: students could choose whether they want to sustain the final examination in oral form, as an interview, or in writing. Oral exams were also a solution before the pandemic. However, these were rare, and students could not necessarily refuse them if these did not suit their pleasures.

Even though face-to-face socialization was drastically reduced, our university provided students with sufficient communication channels so that their voices could be heard permanently. Therefore, the **Microsoft Teams** application is used for conducting online classes, and any issues encountered can be announced through a newly created ticketing system belonging to **UPB Support Center**<sup>17</sup>.

## 2.7 Motivation

Throughout the last five years, feedback had a significant influence on ACS/UPB classes, both in terms of the curriculum taught and carrying out and evaluating activities. Naturally, the advice received from students was listened to and taken into consideration depending on different criteria, like veracity, or utility.

Opinions received from students allowed teachers to continually refresh the content of their courses, to be up-to-date with the latest news and technologies on the market. On the one hand, this idea applies especially to technical engineering universities, given the fantastic progress in this area [14], which might even occur from year to year. On the other hand, analyzing the situation of students that belong to other areas of expertise, for instance, medicine, history, or geography, it goes without saying that whether students fancy it or not, the curriculum cannot

---

<sup>17</sup><https://ticketing.upb.ro/open.php>

permanently be changed.

**Systems Laboratory**<sup>18</sup>, a team made up of professors, teaching assistants, and Ph.D. candidates from our university, emphasizes the importance of feedback. As a result, in addition to actively inspiring students to express their opinions, they always publish a report containing the data collected in a processed form, thus providing transparency for future generations. According to them, *“this processing does not contain all the ideas, so as not to encourage a destructive attitude towards writing feedback. However, the team has received the entire raw feedback.”* [15].

Likewise, apart from the generic feedback questionnaire that students need to complete for each class on Moodle, teachers are also constantly elaborating other more particular surveys, which are focused strictly on the subject of their specific class. Hence, the desire to ameliorate the content of a discipline is quickly noticeable.

As we have in mind all the information exposed throughout this chapter, we admit that feedback is an important note that underlies the evolution of each educational institution.

---

<sup>18</sup><https://systems.cs.pub.ro/>

# Chapter 3

## User study

Before the functionalities implementation process, to achieve a solution as helpful as possible, we decided to perform a study that lucidly emphasizes the needs, desires, and preferences of students. We believe such research is crucial for understanding the obstacles encountered and identifying meaningful enlightening schemes. Moreover, this examination is an ideal way to confirm that the ideas we have thought of meeting follow the requirements of students. The current thesis is based on the statement of Kurt Lewin, a former psychologist established in the United States, which mentions that *“No research without action, no action without research.”*

### 3.1 Methods

To obtain a satisfactory data set, we used several methods to collect various comprehensive answers.

Initially, the most common approach we used for this purpose was our investigation, perception, and examination for four years. We activated both as a Bachelor’s degree student at ACS/UPB and as an employee at a multinational company in Bucharest, Romania. Being a reasonably significant period, we had enough time to live different emotions and experiences. At the same time, our judgment is based on the interaction with different groups of students who have distinctive backgrounds and thoughts. Equally, we were exposed to both physical and online education systems. Therefore we can make a powerful comparison between the two.



In addition, we chose to interview multiple students to discover in more detail their experiences and feelings about our faculty of choice. The main topic of these discussions was focused on collecting insights about how professors and university management perceive students. More precisely, we were interested in finding out if students consider that their opinions matter and, if so, to what extent. Likewise, our targeted students were asked for their points of view on the general importance of feedback in developing the educational process and how much they have contributed over time.

Last but not least, we conducted a survey between November and December 2020, which gathered **108** answers, which represents approximately **20%** out of the total number of students enrolled in a B.Sc. year. It was distributed as a Google Form document on several groups from social networks, both through the aid of our author and the group of Counselors and Senators Students of UPB.

Next, throughout this chapter, we will analyze all the answers received to this form, presenting detailed statistics of the current situation at ACS/UPB.

## 3.2 Target audience

The distributed questionnaire was addressed to students from any year in Bachelor's and Master's degrees, regardless of age, sex, or religious orientation.

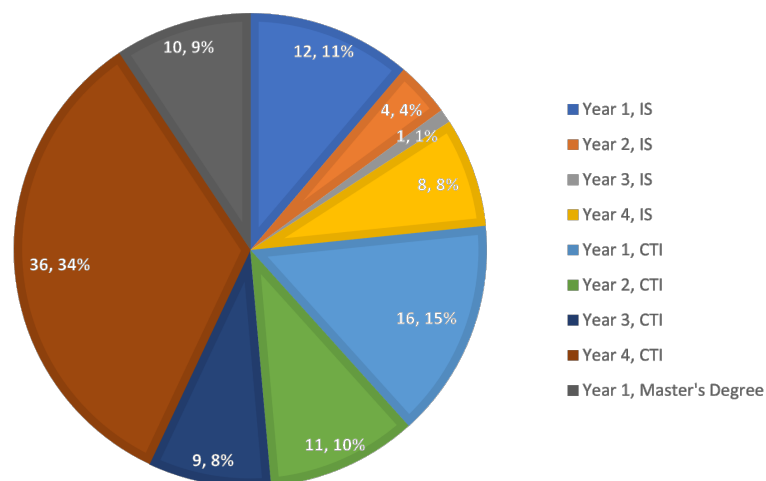


Figure 3.1: Distribution of students according to the year of study and specialization

The highest percentage of responses came from students in the last year of study, B. Sc. At the same time, it is worth mentioning that about **36%** of participants are enrolled in the Systems Engineering (IS) specialization, whereas **54%** follow the Computers and Information Technology (CTI) department studies. In comparison, the remaining **10%** come from various Master's degrees.

### 3.3 Results

We noticed that about half of the total number of students interested in feedback does not always share ideas and thoughts, as seen in figure 3.2. Therefore, students should be encouraged not to disregard this process, always keeping in mind that their opinions can contribute to the better development of the educational system.

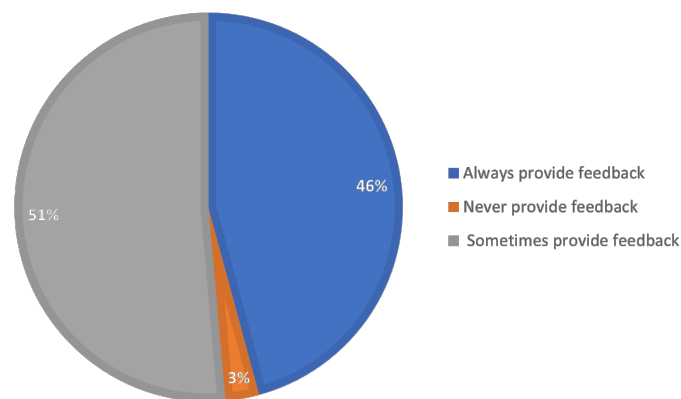


Figure 3.2: Distribution of students who provide feedback or not

Regarding students who always provide feedback, most prefer to use the official Moodle platform and other official forms made by teachers. These statistics are also maintained in case students choose to provide occasional feedback:

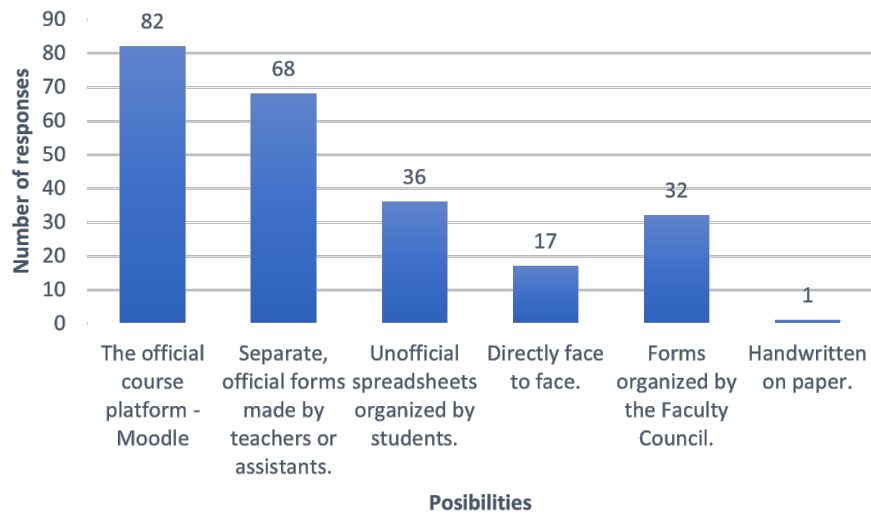


Figure 3.3: Platforms and methods used for sharing feedback

In addition, the main reasons for providing feedback are expressed in figure 3.4:

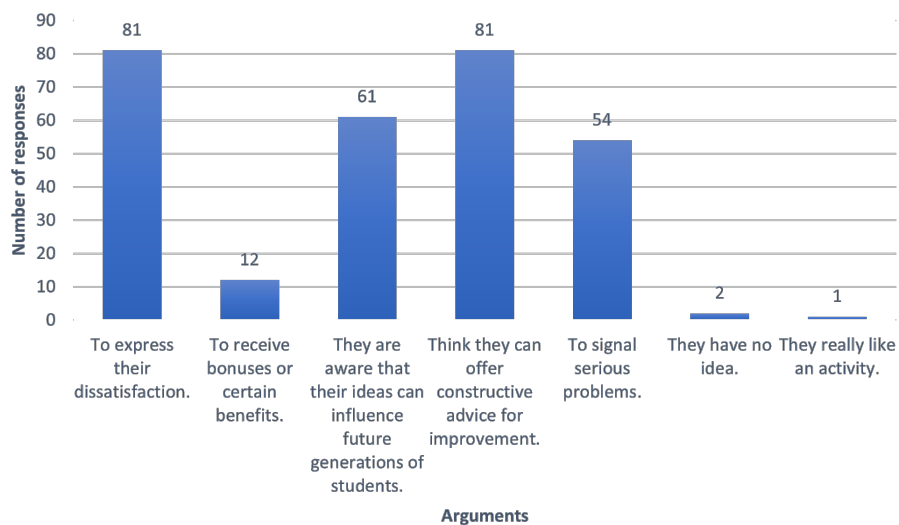


Figure 3.4: Reasons why students provide feedback

Thus, 75% voted for both expressing dissatisfaction and thinking they can offer constructive advice for improvement. Only 11.1% acknowledged that they provide feedback to receive bonuses or rewards, which is a positive and gratifying aspect.

As expected, most students prefer to remain anonymous when sharing their

thoughts or think very well before publishing their names (fig. 3.5). As a result, guaranteeing anonymity and indicating how it is achieved represents an essential aspect of such an application.

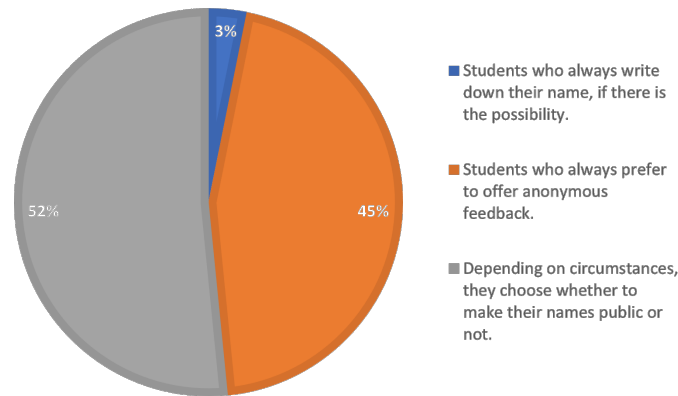


Figure 3.5: Feedback - anonymous or not?

Some ideas that could help create a suitable anonymous environment are:

- feedback boxes or surveys: before being completed, the application may ask students to log out of their account
- using external third-party applications and websites. Many such platforms are implemented, offering many possibilities precisely because feedback is beneficial and vital in society. For instance, some examples of such websites are *polleverywhere.com*, *vevox.com*, *freesuggestionbox.com*, *surveymonkey.com*, or *incognea.to*. These platforms are all free to use, and in addition, some of them also have the option to chat anonymously.

Universities might use the following methods to increase the ways of providing feedback, in combination with gamification features:

- daily pulse check-ins: display a small pop-up on the screen and ask students how are they feeling, simply by pressing a facial expression corresponding to their condition
- short questions to check the satisfaction level of students
- boxes where students can share their daily impressions about a specific topic

In general, most students decide to spend between 1 and 5 minutes filling out a form (fig. 3.6). Moreover, considering that each semester has about 6-7 different classes, providing feedback needs to be simplified to ensure increased participation.

Equally, another solution might be represented by the idea of not overlapping all the forms at the same time. Otherwise, an overhead might arise, which could also lead to complete abandonment.

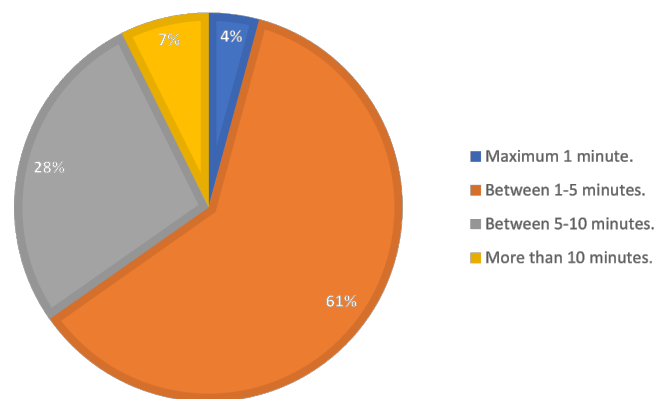


Figure 3.6: The average time taken to complete a feedback questionnaire

Statistics about the reasons that sometimes determine students not to give feedback can be observed in figure 3.7. Therefore, it is quite worrying that over 70% of students cannot identify ideas for improvement and over 65% consider it is pointless, because it will not be examined.

On the contrary, it is gratifying that under 1% of students mentioned they do not complete such questionnaires due to laziness, oblivion, or not being rewarded.

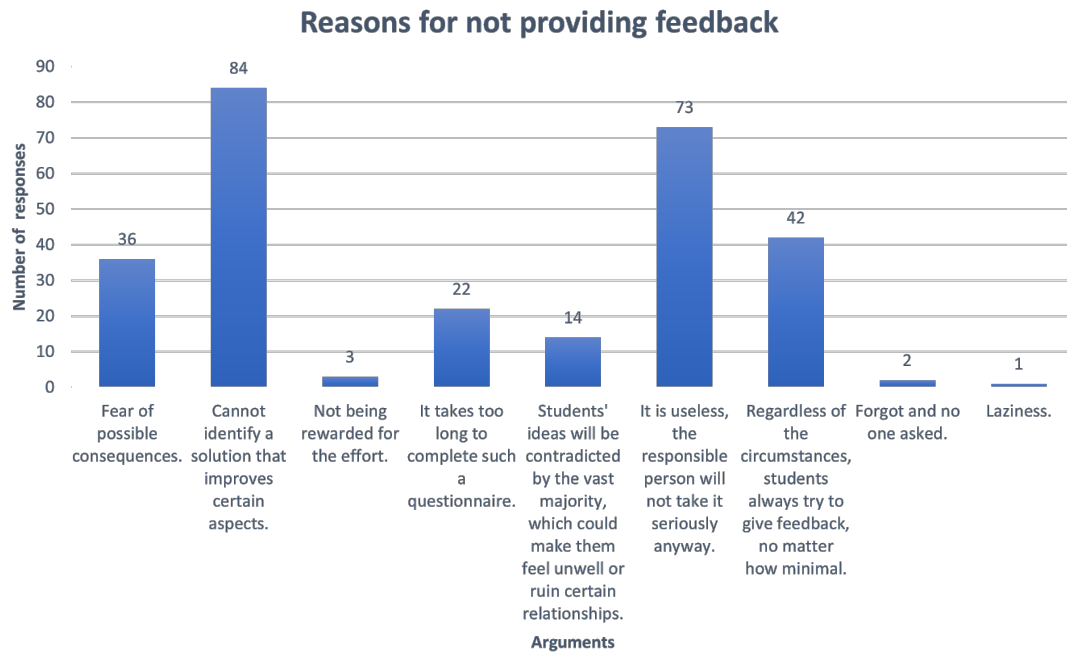


Figure 3.7: Reasons for not providing feedback

Moreover, the vast majority of students said they were interested in finding out what others thought about specific ideas (fig. 3.8). This feature does not exist on the official courses platform, Moodle. Therefore, it is utterly non-transparent in terms of the finality of the feedback.

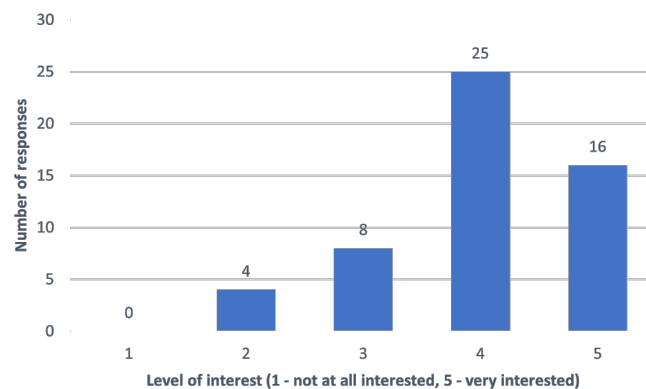


Figure 3.8: Interest of students in the opinions of others

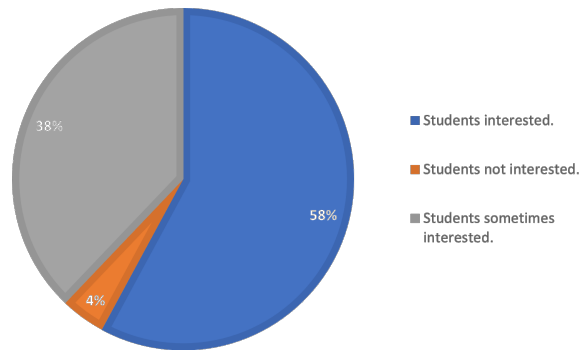


Figure 3.9: Overall interest of students in the opinions of others

However, even if they do not provide feedback, students still seem to be interested in the ideas of others.

Last but not least, we found that a very high percentage of answers from students specify that they want to know more details corresponding to tips and tricks, the amount of homework received and the effort required to solve it, and whether to choose a class as optional or not:

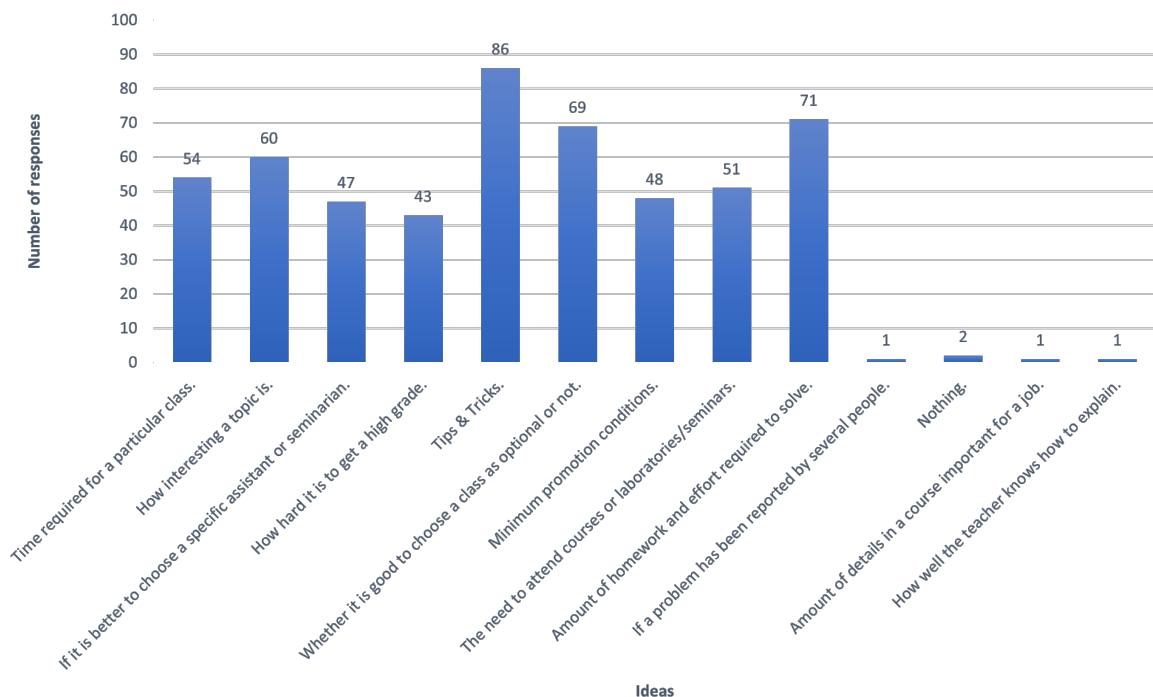


Figure 3.10: Main points of interest for students

# Chapter 4

## UX & UI design

The interface of an application represents the main component with which the user interacts directly. By offering a predictable, concise, and consistent design, students will be motivated to use our solution. Hence, we prioritize the appearance of our application and the ideas that might lead to an overall increased satisfaction level.

### 4.1 Requirements

Our application is conceived to be suitable for Android, iOS, and web users. Thus, we create a design that contains good graphics for any device used by students.

According to a study [16] performed in 2020 about developing applications in Flutter (the framework we use for implementation and which is further described in section 5), this technology offers a high degree of flexibility in modeling an attractive design. Simultaneously, it offers a fast implementation process due to an extensive range of ready-to-use widgets<sup>1</sup>, which can also be adapted depending on the device used, having a single codebase.

The UI elements we use in this application are *Material Design*<sup>2</sup> and *Font Awesome*<sup>3</sup> icons in an outlined variant and *unDraw*<sup>4</sup> illustrations. These provide a modern and catchy look to our solution so that students are encouraged to use it.

---

<sup>1</sup><https://flutter.dev/docs/development/ui/widgets>

<sup>2</sup><https://materialdesignicons.com/>

<sup>3</sup><https://fontawesome.com/>

<sup>4</sup><https://undraw.co/>



Moreover, to ensure suitable formatting of our pages for different screen sizes, we position the graphic elements relative to each other to preserve the proportions.

## 4.2 Feedback questionnaire

### 4.2.1 Motivation

To collect adequate opinions from students regarding their classes, we carefully chose the set of questions, further described in section 4.2.3. These are as varied as possible and cover a wide range of possible aspects that can be improved, such as lectures, applications, or homework.

Considering that constructive feedback is always based on sincere thoughts and individual student voices, it is crucial to collect as many free answers as possible through explicit wordings. The thinking of students should not be limited only to the selection of some already predefined statements.

However, time spent on a questionnaire determines whether to participate in completing it or not [17]. Thus, single or multiple-choice queries, *Likert* scale, and dropdowns questions should not be completely absent. These types allow students who do not want to compose much or describe their feelings to offer any echo, helpful in obtaining a certain kind of perceptible data [18].

Additionally, a well-composed form should not mark all fields as mandatory to be answered because some people may feel compelled to express their attitude even if they desire to abstain. Nevertheless, this freedom does not have to be complete either because some may be encouraged to quickly overlook and forget to have their say on the required topics. Furthermore, the more concrete a question is, the more an answer might contribute to class enhancement. A balanced combination of all these concepts can significantly influence how students perceive providing feedback in the educational domain.

Students should be instructed on the role and purpose of this feedback form, more precisely why their opinions are meaningful, and explain how these influence the development of the educational process. Therefore, the probability of students completing this evaluation might increase if they will be informed that teachers seriously consider changes based on their observations.

Although some believe that feedback is not entirely anonymous, it must be

rigorously explained how all the data provided is stored in the database and that there is no connection between the name of a person and his answers. However, a reference must be maintained to specify whether a student has submitted the feedback form for a specific class as not to allow multiple times completion. Besides this, it must be stated that their viewpoints will never be forgotten and unused by simply publishing them on a statistics page, to be analyzed by future generations as well.

### 4.2.2 Structure

Before we composed the most appropriate questions, we organized them in several categories so that the mind of the person fulfilling is neither puzzled nor passed from one section to another one. Like the online course platform Moodle, the underlying divisions of the educational process include general accommodation questions, followed by a more profound investigation about the lecture, laboratory, seminar and applications, homework, percentage of participation in the overall class activities, and personal questions.

Unlike Moodle, which focuses on feedback before taking the exam session, this application wants to collect reviews, including final evaluation impressions. Through this, future generation students can learn valuable insights, such as how difficult it is to understand the overall class theory or how hard it is to pass the exam. Therefore, in contrast to the Moodle direction, the purpose of the feedback form in this application is to aid teachers and students.

Undoubtedly, by considering this approach, there is always a risk that specific students may suddenly change their thoughts about a class, which they may even have beloved, if the final examination does not go as well as they would have imagined or if it did not meet their expectations. Despite this fact, it must be considered that it will include the good, the bad, and the ugly whenever we open ourselves up to feedback. No matter how heavily someone might try, there is a remarkably tiny probability that negative comments and insults will be everlastingly null. Instead, the solution to which we must pay exclusive emphasis is based on identifying means that can substantially reduce criticism until we reach the ideal situation.

Therefore, no student should ever address offensive words or false opinions, which do not respect the objective reality. Naturally, it is impossible to please

everyone repeatedly. As a result, when those critiques show up, their reason must be identified and subsequently reflected on how their reappearance could be avoided.

After establishing the categories, the manner of defining a question should not be neglected. The way an inquiry is asked may or may not encourage the receipt of a particular type of answer. For instance, by introducing a question like *"What did you dislike about this class?"*, we open ourselves for harsh responses like, *"I did not like anything. I cannot stand this class."* Nevertheless, if we are careful to immediately insert a follow-up question like *"What do you suggest to improve the negative aspects mentioned before?"*, the presumption of receiving a pragmatic justification is not guaranteed but increases noticeably. Therefore, the most powerful tool that guides someone in this context is represented by anticipating possible comments and thinking on how to induce the interviewees to envisage by providing their most valuable feedback.

### 4.2.3 Chosen questions

Among the questions [19] we added in this application are:

- ***"How does this class contribute to your stress level?"***: as it is well known, no one desires to study or carry out their activities in a tense environment. Stressful experiences contribute to a significant impact on the mood of students, being at the same time a critical factor that could cause them to express their anger in a feedback form. This indignation might obscure positive thoughts of students about a class, opinions that could have even acknowledged that the theory learned throughout the semester is helpful to them in their future careers. As a result, teachers should permanently challenge students to reach their maximum potential while maintaining certain limits. Of course, students need to be pushed out of their comfort zone but taking care to have at the same time a balanced ambiance.
- ***"Identify your effort level for this class."***: this is a handy question for both students and teachers, thus making them aware of how far a class is located compared to other disciplines that offer the same number of credits in terms of difficulty.

- ***"What is one aspect you would change about this class? How do you think it should be revised?"***: by aggregating the answers to this question, generations of students to come will be aware of the existing imperfections from a specific class and will be able to propose multiple possibilities for improvement.
- ***"What advice would you give to future generations of students about this class?"***: playing a prominent role in maintaining the connection between students, this question contributes to the accountability of older students while the youngest benefit from various opinions.
- ***"What are you proud of accomplishing in this class?"***: it is genuinely essential to highlight accomplished successes to arouse the interest and motivation of students to learn and manage to achieve results at least as satisfying as their previous generation. Therefore, this question stimulates continuous progress and encourages educational advancement. Students will be boosted to get out of their comfort zone and set their sights as high as possible. Without any quest to look forward to, there is always a real threat of not valuing our capabilities enough.
- ***"Did you take the exam?"***: unlike other queries that can receive more complex answers, this is a straightforward inquiry to identify the pass rate of a specific class, one of the most sought-after information among students.
- ***"How much time did you have to prepare for the exam?"***: one of the questions that students frequently ask to help them manage their schedule better and realize how dense the information to be retained is.
- ***"What grade did you get in this class?"***: short and to the point question, which helps students easily visualize their level compared to others or, for those who are going to study the discipline, the overall average grade.
- ***"Do you think the knowledge gained will be useful in your future career?"***: naturally, not all the theories studied will always be advantageous in our professional development. Everyone has their passions, being more or less attracted to specific topics. However, the purpose of this question is to identify cases in which a student is particularly attracted to a subject. Results obtained in this category can be subsequently interpreted by both students and teachers, thus serving in the continuous process of remodeling

the discipline.

- "*Was the exam easier than in other classes that offer the same number of credits?*": a question that offers an insight about the comparison between different classes and whether there is a level of balance or not.

## 4.3 Prototyping

### 4.3.1 Initial design

Based on our experience, we confirm that the appearance of an application influences users on whether to continue using it or not. As a result, we pay great attention to creating a concise, attractive, and easy-to-understand interface. Along with these characteristics, we consider the idea of having a uniform, airy, and user-friendly layout.

According to a study conducted in 2009 [20], conceiving the right design for mobile devices is a challenging process. As we strive to ensure an excellent level of satisfaction to students, the action of defining a good-looking prototype preceded the process of implementing the architecture itself, described in chapter 5.

We sketched the aspect of our project in Figma<sup>5</sup>, taking care to maintain the theme of the already implemented modules (fig. 4.1 - 4.5).

Initially, the role of the prerequisites page (fig. 4.1) was thought to inform students about the approximate time required to complete a feedback questionnaire and agree to provide constructive information. However, we decided to reduce the number of clicks a user must perform and removed this page.

Moreover, apart from the classic form students need to complete at the end of each academic semester, we sketched a *vibe check* feature. Its role is to collect information about the mood of students after attending a course, laboratory, or seminar. The interface presented is intuitive and uses emoticons to collect data from students. This idea was

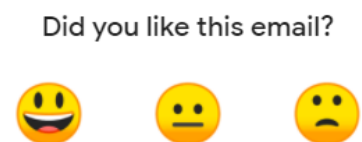


Figure 4.6

<sup>5</sup><https://www.figma.com/>

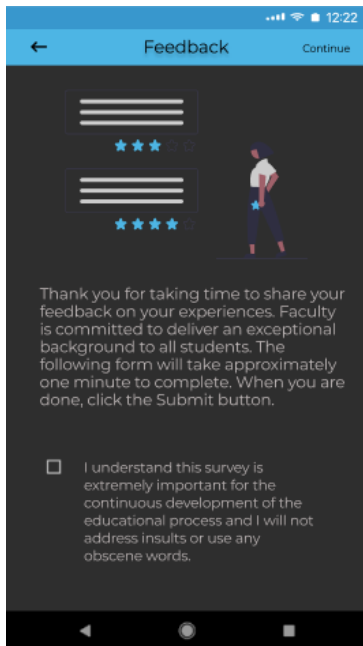


Figure 4.1: Feedback prerequisites mock-up

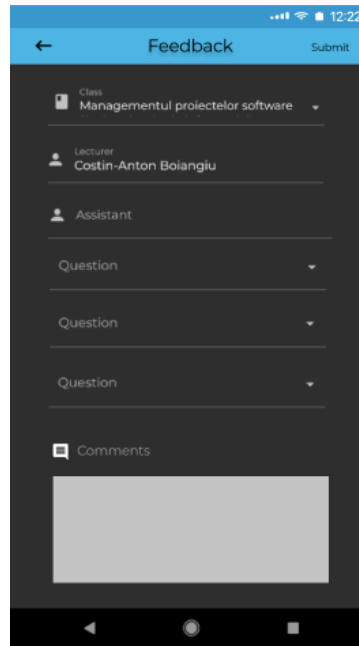


Figure 4.2: Feedback questionnaire mock-up

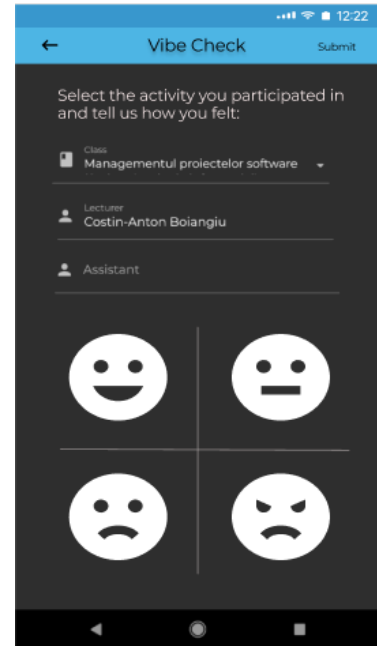


Figure 4.3: Vibe check mock-up

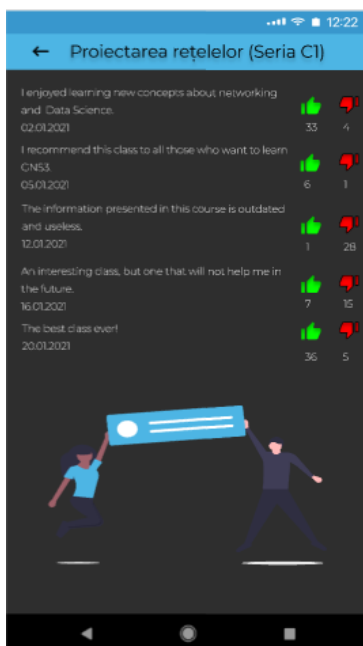


Figure 4.4: Opinions page mock-up

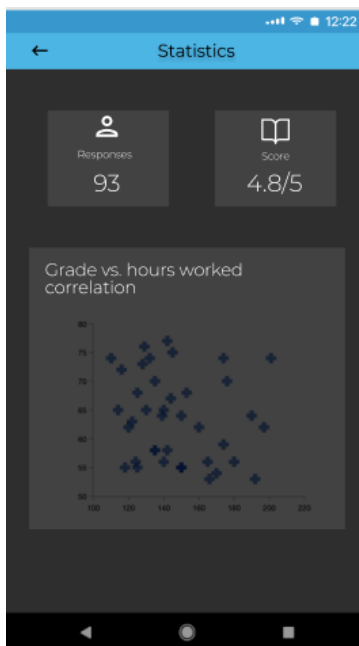


Figure 4.5: Statistics overview mock-up



inspired by the template used by Google Maps<sup>6</sup>

<sup>6</sup><https://www.google.com/maps>

Timeline emails to collect impressions from students, as illustrated in figure 4.6.

### 4.3.2 Final design

We followed an iterative process of design development to reach a pleasant and intuitive interface for our application. Overall, we maintained the ideas outlined in the previous section 4.3.1, to which we added minor improvements.

To ensure that our application benefits from a clean and catchy layout with smooth transition between pages and readable information, we constantly received advice from a UX & UI designer.

In terms of UX, the feedback questionnaire (fig. 4.10) was initially accessible only from a class page by pressing a suggestive icon in the top right corner. Since students could easily omit this feature, we implemented a notification on the Home page that announces students how many feedback forms are still available to be completed (fig. 4.7).

By pressing the notification, users are redirected to a feedback checklist page (fig. 4.11) that displays a list of all the forms that were already submitted or not, thus providing an overview of them. Naturally, students can navigate to

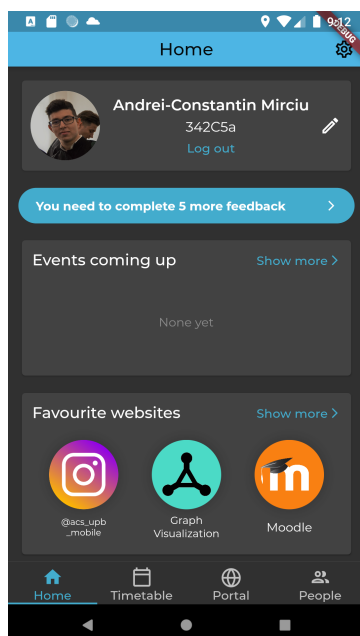


Figure 4.7: Feedback notification on the Home page

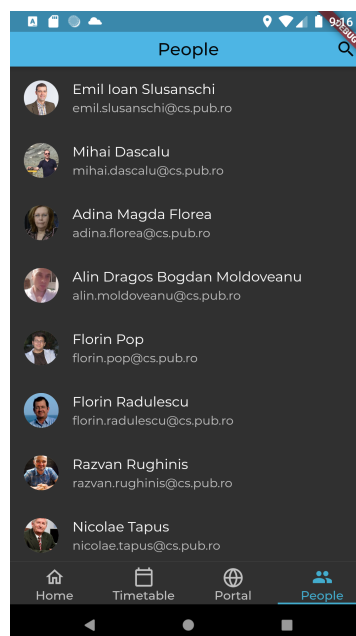


Figure 4.8: People page

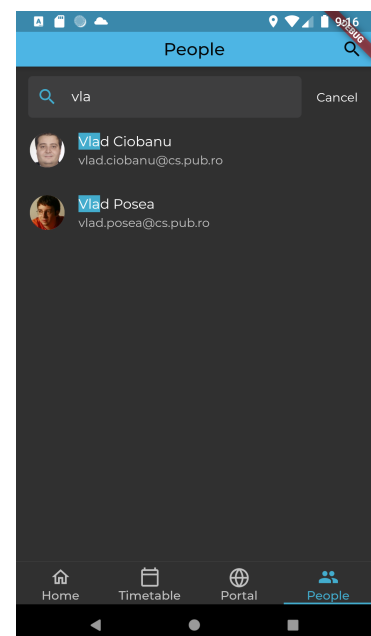


Figure 4.9: People page search option

The figure displays three sequential mobile app screens for a feedback questionnaire. The first screen, titled 'Feedback', includes a header with a back arrow and 'Send' button, a note 'This form is anonymous.', class and lecturer information, an assistant field, a consent checkbox, and a 'General questions' section with a grade slider. The second screen continues the 'General questions' section with a grade slider and an 'Involvement' section with a dropdown menu. The third screen, titled 'Personal comments', contains three text input fields for open-ended feedback.

Figure 4.10: Feedback questionnaire page

a specific form directly through this page by tapping an unchecked entry.

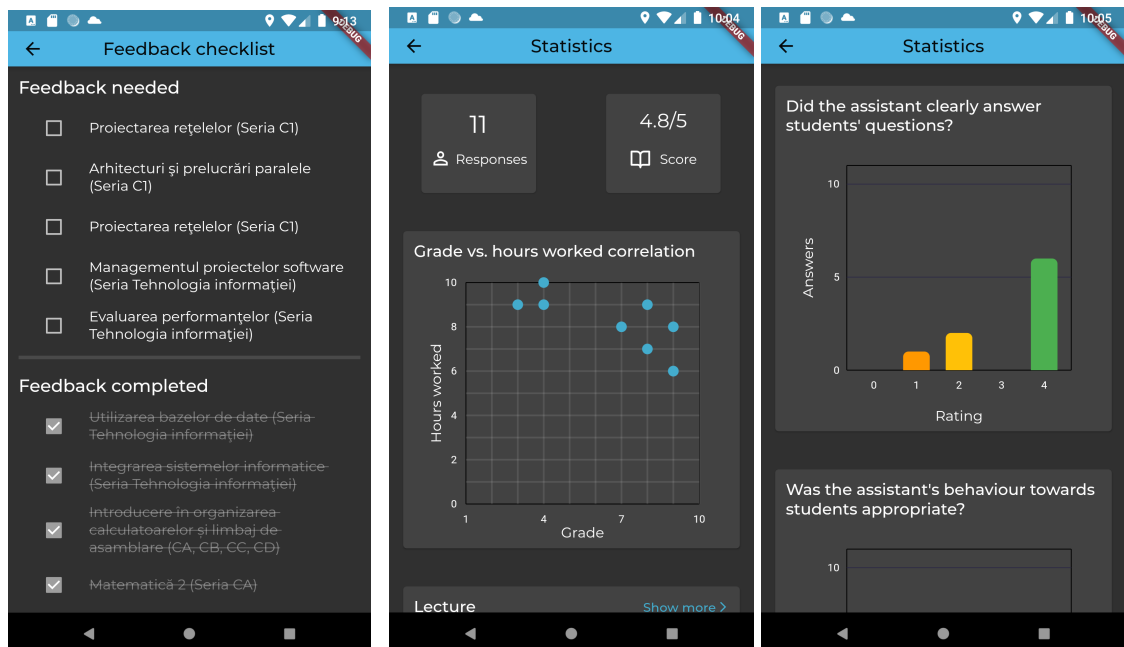


Figure 4.11: Feedback checklist page

Figure 4.12: Feedback statistics page

Our application offers students the opportunity to view statistics (fig. 4.12)



for each of their classes. Therefore, we emphasize the total number of students who shared their opinions and display a score computed as the arithmetic mean of all the ratings provided by students for each category of questions. Moreover, we added a scatter plot highlighting the correlation between the final grade and the average number of hours allocated to the study per week. To present the rest of the information collected from students, we have also introduced different bar charts or pie charts.

The people page (fig. 4.8) has a concise but straightforward and easy-to-use design. The search bar option (fig. 4.9) is case-insensitive, and it is shown on the screen only after pressing the corresponding icon.

# Chapter 5

## Architecture

The architecture of this project is developed using an Object Oriented Programming (OOP) approach such that each data type and its associated methods are kept in separate classes. Furthermore, this application actively uses concepts involving data encapsulation and abstraction, inheritance, polymorphism, and dynamic binding.

### 5.1 Mobile technology

Smartphones have become indispensable to human life, especially since they began to replace the need for additional gadgets, besides the leading role of calling people.

As a result, we opted to implement a mobile solution for students. We offer a painless and favorable user experience on a device not missing from the pocket of anyone. Thus, students can find various information or conveniently perform multiple tasks and actions in a time-saving manner.

**Flutter**<sup>1</sup> represents a cross-platform toolkit developed by Google that allows the development of attractive designs without significant effort, given the multitude of already predefined UI components, called *widgets*.

As technology, Flutter uses **Dart**<sup>2</sup>, a client-optimized solution that allows great development flexibility, null safety features, built-in collections, and support for asynchronous methods. Equally, this technology grants fast incremental compi-

---

<sup>1</sup><https://flutter.dev/>

<sup>2</sup><https://dart.dev/>

lation for applications targeting mobile and desktop devices, as well as the web environment.

## 5.2 Database

To benefit from a database with real-time information updates, built-in security mechanisms, and cloud storage convenience, we continued using the services offered by **Firestore**<sup>3</sup>, as described in *Design and Implementation of a Cross-Platform Mobile Application That Facilitates Student Collaboration* [4].

### 5.2.1 Firestore

**Cloud Firestore** represents a NoSQL type database designed for both mobile and web development applications. With its help, data can be stored in different collections. In its turn, a collection is made up of multiple documents, and each document can contain from elementary strings, booleans, and numbers, to complex, nested objects in addition to subcollections. At the same time, it is not mandatory that all the documents located in a collection have the same fields, but on the contrary, they may differ.

As a result, we can confirm that Firestore offers a substantial degree of flexibility to an application by maintaining a dynamic architecture for unstructured data. Furthermore, it provides the ability to handle a large volume of requests from users simultaneously, and it is not dependent on a permanent connection to the Internet. Thus, Firestore has the advantage of providing support for offline actions by caching actively used data. Eventually, any offline modifications performed will be synchronized again when the online connection is restored.

### 5.2.2 Database structure used

To manage all the references about users, people, questions, and answers of the feedback form, our application uses several separate collections. Therefore, we can administer and systematically handle all the details stored efficiently.

As our project benefits from a flexible structure, we consider the possibility of specific fields from a document to have a null value, especially if a student does

---

<sup>3</sup><https://firebase.google.com/>

not want to answer a particular question. However, to reduce the total number of *read* and *write* operations (fig. 5.1) and the size of the database, we decided not to store any empty information.

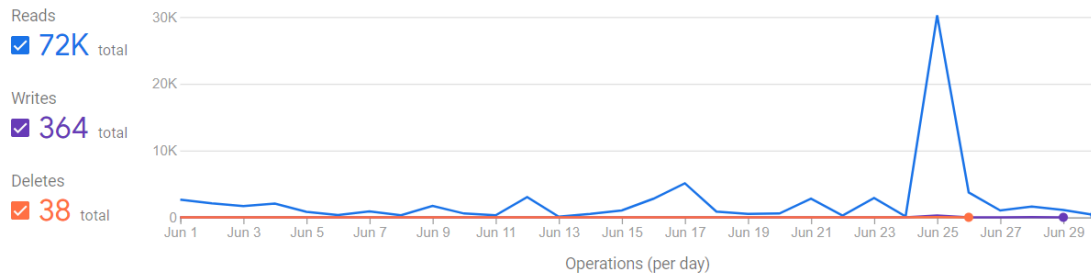


Figure 5.1: Number of operations for our application, as reported by Firestore, in the last 30 days

We will further present the collections used in this application from the point of view of all the data that represents the subject of this thesis.

### **users**

This collection permits storing data about the classes of a student, together with a list mentioning all the subjects where the feedback questionnaire was already completed. This information is required as not to complete the feedback form for a specific class more than once.

Table 5.1: **users** collection additions

Field	Type	Required?	Additional info
classes	array<string>	☑	list of classes in which the user is enrolled
classesFeedback	map<string, boolean>	☒	specifies whether the user completed or not the feedback form for a class

### **people**

This collection has been defined since the first version of the application [4]. It contains details that reference the name, email address, photo, and position of a teacher, along with their office location. However, we have also added information related to the department of a teacher, along with their phone number. Each field in this collection is a *string*, including their picture, represented as a URL.

### **forms**

This collection represents the primary source of information for the functionalities described. Initially, its purpose was to collect requests from users to change their permission level to contribute with various details introduced in the application, such as events in the timetable or information about a particular class, like grading, valuable links, and resources. This form can be accessed by each user from the *Settings* page of the application.

Table 5.2: **forms** collection structure

Field	Type	Required?	Additional info
addedBy	string	✗	the ID of the user who submitted the request
dataSubmitted	timestamp	✗	field that records the timestamp when a request was sent
requestBody	string	✓	actual message sent by a user

Subsequently, to benefit from a database architecture as compact as possible, we decided to introduce two other documents in the same collection.

The first document is responsible for storing all the questions from the feedback questionnaire and their corresponding categories. The structure of this document is presented in table 5.3. In addition, we outline the format of a question in table 5.4.

The second document has a more complex structure. It is composed of multiple subcollections, whose keys are defined by the number of the question in the feedback form. Furthermore, each subcollection consists of a list of documents with an automatically generated key, while each document represents the answer

submitted by a user to that question. As we reach the end of the hierarchy, an answer is composed of the actual value (the result or the comment provided), together with the details related to a class (its name, associated teacher, and assistant). To provide anonymity, we do not retain the ID of the user who completed a questionnaire. The structure of this data set is highlighted in table 5.5.

Table 5.3: **class\_feedback\_questions** document structure

Field	Type	Required?	Additional info
categories	map<string, map<string, string>>	✗	nested map composed of the category name as key and another map as value, which stores pairs of elements that contain the language reference and the corresponding localized category name
questions	map<string, feedback_ question>	✗	the data structure which stores all the questions from the feedback form

Table 5.4: **feedback\_question** type structure

Field	Type	Required?	Additional info
category	string	✗	category name; the value of this field corresponds to the key of the nested map <i>categories</i> from <b>class_feedback_questions</b> document
question	map<string, string>	✗	stores the actual question as value, while the key specifies the language ("en", "ro")
type	string	✗	one of: "rating", "dropdown", "text", "slider"
options	array< map<string, string>>	✗	answer options for dropdown questions; key of the map contains the language, whereas the value corresponds to the localized answer

Table 5.5: `class_feedback_answers` collection structure

Field	Type	Required?	Additional info
answer	string	<input type="checkbox"/>	actual value of the answer provided for a question
assistant	string	<input checked="" type="checkbox"/>	name of the assistant
class	string	<input checked="" type="checkbox"/>	id of the class for which feedback is given
dateSubmitted	timestamp	<input checked="" type="checkbox"/>	the field that records the exact time when the feedback form was sent
teacher	string	<input checked="" type="checkbox"/>	name of the teacher

### 5.2.3 Remote Config

**Remote Config**<sup>4</sup> is a service provided by the Firebase platform, which can make changes in our application without republishing it.

In our case, we propose a solution that offers students the ability to provide feedback only within a well-established time frame. Thus, although our functionalities will everlastingly be integrated with the application, these will not always be accessible by our users.

To initialize this option, we defined a parameter (fig. 5.2) based on which features we offer are hidden or not. It contains a default value and the condition (fig. 5.3) that can modify it.

Name	Condition	Value	Fetch %
feedback_enabled	Enable feedback option	true	100%
	Default value	false	0%

Figure 5.2: Remote Config parameter values, as shown in the Firebase interface

<sup>4</sup><https://firebase.google.com/docs/remote-config>

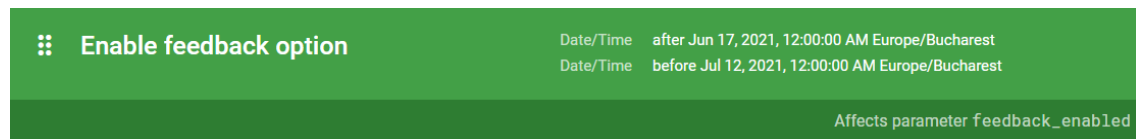


Figure 5.3: Condition used to enable feedback, as displayed by Firebase

We implemented the Remote Config option using the **Singleton** design pattern to restrict its instantiations to a single object. Moreover, we define a map that stores a default value that needs to be used if the application cannot fetch the configuration parameter from the database.

## 5.3 System implementation

The contribution<sup>5</sup> to this project respects a strict policy of code writing so that the structure of the application is modular and easy to understand. Moreover, boilerplate code sections are almost non-existent since we are constantly looking to reuse already developed components.

### 5.3.1 Development process

To obtain a satisfactory final result, the whole mechanism we use for development is quite complex, and it follows a well-established code of conduct<sup>6</sup>.

Firstly, the act of planning and analyzing plays a crucial role in order to create valid and reliable solutions. All our decisions are implemented after consultation with the entire project team.

We use *git*<sup>7</sup> as a way to version the code and **GitHub** as a hosting service. Therefore, each developer needs to work on his branch. Each contributor has to submit a new Pull Request (PR) to maintain visibility on the implementation. Our contribution can be merged into the production environment after a serious review process. In addition, each PR needs at least one approval from a team member.

To remove error-prone situations, our project uses two different databases for both production and development environments. In this way, we ensure our

<sup>5</sup><https://github.com/student-hub/acs-upb-mobile/blob/master/CONTRIBUTING.md>

<sup>6</sup>[https://github.com/student-hub/acs-upb-mobile/blob/master/CODE\\_OF\\_CONDUCT.md](https://github.com/student-hub/acs-upb-mobile/blob/master/CODE_OF_CONDUCT.md)

<sup>7</sup><https://git-scm.com/>



users that their data is not accidentally altered or modified.

Overall, although the policy of our system is based on a relatively slow-moving advancement, it allows us to offer users a well-defined and error-free ecosystem.

### 5.3.2 Project structure

This project uses the **BLoC** (Business Logic Component) design pattern, slightly modified by separating the UI modules from the actual data layer and providing a state management system, in combination with the use of provider modules. The entire logic of this configuration is focused on accepting and processing events, based on which the state of any page in the application can change.

To respect the database structure described in section 5.2.2, we organized our setup in multiple packages (an example is illustrated in fig. 5.4), depending on their role:

- **model:** represents the data level of the application
- **service:** contains all the providers that interact directly with our database; according to the developers<sup>8</sup> of this concept, a provider has the role in *creating, listening, or dispose* of the information; each provider module defined has precise methods by which data is extracted or added
- **view:** represents the presentation level of the application; it displays the model information to each user

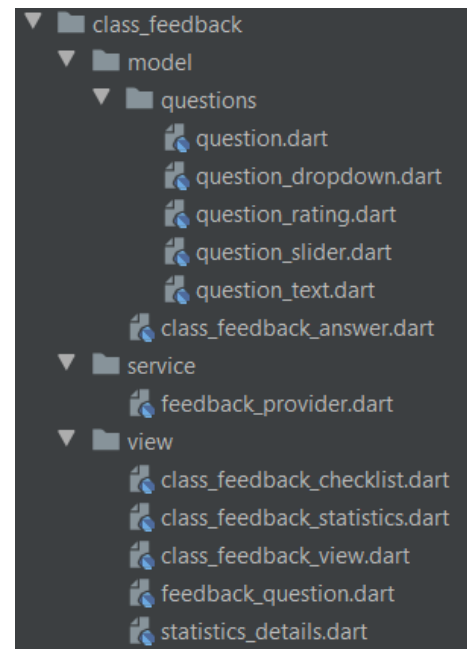


Figure 5.4

## 5.4 Testing

Being an application that benefits from continuous development from our team, each student working on its task, testing our features becomes mandatory.

<sup>8</sup><https://pub.dev/packages/provider>

Although we could consider, at first sight, that everything works nominally following some code changes in our application, it has been proven that we might wake up with unpleasant surprises any time, even at the slightest adjustments.

Our team relied on manual and automatic testing throughout the various functionalities implemented, verifying our code additions rigorously.

Since our project consists of a cross-platform solution and considering the multitude of gadgets available on the current market, our initial step in developing the test modules was to define several screen resolutions, for instance, 720x1280 or 600x1024 pixels. Therefore, we can ensure that UI elements are displayed properly, regardless of the device used.

Moreover, regarding packages used, our application adopted the *flutter\_test*<sup>9</sup> library, which allows the verification of each UI component, including different page navigation and buttons pressing simulation. According to *Codecov*<sup>10</sup>, our complete set of features is currently being tested in a proportion of approximately 68%. In addition, the evolution over time can be observed in figure 5.5:



Figure 5.5: Code coverage evolution

However, the difference up to 100% is caused by the lack of testing for the provider modules interacting with Firestore. Thus, we had to mock our database directly in the test files, including the results of all asynchronous calls used in communication with every Firebase section. As a result, we frequently had to deal with flaky tests, so we are thinking about refactoring all testing processes using *flutter\_driver*<sup>11</sup> dependency.

<sup>9</sup>[https://api.flutter.dev/flutter/flutter\\_test/flutter\\_test-library.html](https://api.flutter.dev/flutter/flutter_test/flutter_test-library.html)

<sup>10</sup><https://about.codecov.io/>

<sup>11</sup>[https://api.flutter.dev/flutter/flutter\\_driver/flutter\\_driver-library.html](https://api.flutter.dev/flutter/flutter_driver/flutter_driver-library.html)

# Chapter 6

## Conclusion

This application uses production-ready systems and tools for offering stability and scalability, as previously described in chapter 5. It contains various modules designed to provide ease of use, transparency, and a structured data set.

### 6.1 Results

We published the application on **Google Play**<sup>1</sup> in March 2021. This represented a significant step both from the perspective of the development process and in terms of advertising. Before this date, users had to manually download and install the application *APK* installation file from our GitHub repository. Undoubtedly, this aspect was a significant disadvantage for our users for several reasons: lack of reliability and complicated installation method.

After about three and a half months later, at the end of June 2021, our application has gathered more than **140** Play Store downloads and **17 5-stars** ratings. In addition, according to Firebase Analytics, more than **300** students have already registered their accounts, and more than **100** students are actively using our solution, as can be observed in figure 6.1. On average, the application benefits from approximately three daily users, especially on Android devices.

---

<sup>1</sup>[https://play.google.com/store/apps/details?id=ro.pub.acs.acs\\_upb\\_mobile](https://play.google.com/store/apps/details?id=ro.pub.acs.acs_upb_mobile)

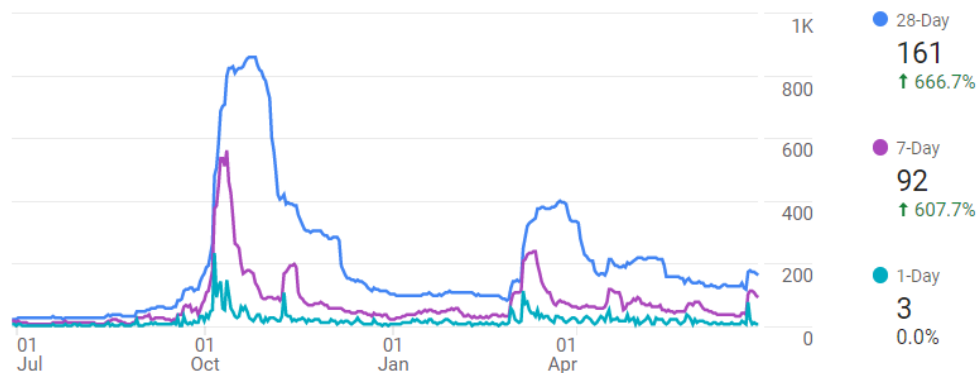


Figure 6.1: Active users, according to Firebase, plotted over the last **12** months

Students proved that they are generally delighted with the experience offered by this application. They shared with us appreciations about the people page and claimed that it frequently helped them quickly search for the contact details of a teacher. Moreover, some students mentioned that the feedback form has a catchy design, mainly thanks to the Likert scale questions, whose responses are represented by emoticons.

We have already started to collect real answers from users in our production environment based on the feedback form implemented. Equally, we noticed a greater interest in using this feature among first-year students. This represents a gratifying aspect and demonstrates that students are eager to help each other with advice on the subjects studied.

Although the application received overall positive feedback from users, we were suggested different ideas for enhancement. Thus, students expressed their desire to see in the timetable the periods when feedback questionnaires are enabled, just like vacations or exam sessions. Furthermore, we were advised to split the feedback form into multiple pages since it is pretty long. In the same manner, this modification would aid in better organization of the questions, and the UI will be airier.

On the statistics side, we received recommendations from students to display results for a specific series, specialization, or study program. Thus, students could find out general information more quickly without exploring the reviews of each class independently.

## 6.2 Future improvements

Although our application offers multiple functionalities even in the current stage, there are still many ideas that we will focus on further developing.

### 6.2.1 Gamification

Gamification is a recently introduced concept that favors a more interactive and pleasant experience among users. According to a study performed in 2017 by Christo Dichev and Darina Dicheva [21], this feature might have a significant impact on the educational environment by increasing the motivation of students to contribute to the well-being of this application. Thus, students will be rewarded with experience points as long as they add or complete various details from the application, like events in the timetable or feedback forms. Students will increase their level based on the points earned and receive specific badges or symbolic nicknames like modern games.

Likewise, we plan to implement a globally visible leaderboard, highlighting the most active users and benefitting their competitiveness. As a result, the higher the score accumulated is, the more permissions students will receive in the application.

Naturally, this module must also allow the discouragement of malicious students by decreasing their scores in case of intentionally adding erroneous or offensive information. In the worst-case scenario, this module should be capable of automatically retrieving access to our resources for students who lamentably violate the content of this application.

### 6.2.2 Filtering

Since about a third of all questions from our questionnaire are open-ended, we offer students a high degree of freedom to express their thoughts. Nonetheless, although the purpose of our application is to encourage constructive feedback from students, we cannot completely prevent users from sharing their frustration through offensive comments.

Even though we cannot guarantee an ideal environment with our solution, we intend to approach an optimal model. Therefore, to ensure that no inappropriate

opinions are introduced in the application, we plan to integrate a feature that allows filtering the reviews offered by students.

Perspective API<sup>2</sup> represents a suitable example in this respect. This framework calculates a threshold for each message, based on which we can establish a degree of toxicity. When the threshold is exceeded, the comment identified as offensive will be automatically excluded from our application. Thus, we ensure our users high-quality information by blocking any harmful words.

This idea of filtering negative comments uses a **Machine Learning** (ML) model, and the API<sup>3</sup> provided is hosted on Google Cloud Platform<sup>4</sup>. We need to create a Firebase Cloud Function<sup>5</sup> which evaluates each comment added in the *forms* collection and marks it as appropriate or not. Hence, we expect a relatively straightforward implementation of this feature.

## 6.3 Mentorship

We are constantly trying to expand our team and encourage students to contribute as much as possible to the development of this open-source project. As a result, we decided to post an unpaid recruitment ad on a well-recognized platform for offering internships to students, called SPB<sup>6</sup>. After about a month, our announcement caught the attention of over **100** students from different universities. Since this is a rather considerable number, we organized a recruitment process and interviewed the most suitable candidates that could deal with the future functionalities presented in section 6.2 and beyond.

Finally, we succeeded in finding **15** students who have demonstrated that they are interested and willing to continue implementing this project. They asked us pertinent questions regarding the structure of the project and the methods used for storing all the data. A mentor from our initial team will guide each newcomer. Thus, we promote the idea of making students more responsible and facilitate collaboration between them. Likewise, our project simulates a work environment similar to an official company in the IT&C industry.

---

<sup>2</sup><https://www.perspectiveapi.com/>

<sup>3</sup><https://developers.perspectiveapi.com/s/about-the-api>

<sup>4</sup><https://cloud.google.com/>

<sup>5</sup><https://firebase.google.com/docs/functions>

<sup>6</sup><https://stagiipebune.ro/home/>

# Abbreviations

**ACS** Faculty of Automatic Control and Computers. 6, 9, 14, 15, 19, 21, 22, 24, 25

**API** Application Programming Interface. 54

**APK** Android Package Kit. 51

**BLoC** Business Logic Component. 49

**IT&C** Information Technology and Communications. 54

**ML** Machine Learning. 54

**NGO** Non-Governmental Organization. 9

**OOP** Object Oriented Programming. 42

**PR** Pull Request. 48

**SQL** Structured Query Language. 43

**UI** User Interface. 4, 10, 21, 32–42, 49, 50, 52

**UPB** University POLITEHNICA of Bucharest. 6, 9, 14, 15, 19, 21, 22, 24, 25

**URL** Uniform Resource Locator. 45

**UX** User Experience. 4, 10, 32–41

# Bibliography

- [1] A. W. Bernard, N. E. Kman, and S. Khandelwal, "Feedback in the emergency medicine clerkships," *Western Journal of Emergency Medicine*. Available: <https://doi.org/10.5811/westjem.2010.9.2014>, vol. 12, no. 4, pp. 537–542, November 2011.
- [2] D. P. Moynihan and J. Soss, "Policy feedback and the politics of administration," *Public Administration Review*. Available: <https://doi.org/10.1111/puar.12200>, vol. 74, no. 3, pp. 320–332, April 2014.
- [3] M. Henderson, T. Ryan, and M. Phillips, "The challenges of feedback in higher education," *Assessment & Evaluation in Higher Education*. Available: <https://doi.org/10.1080/02602938.2019.1599815>, vol. 44, no. 8, pp. 1237–1252, 2019.
- [4] I. Alexandru. (2020, July) Design and implementation of a cross-platform mobile application that facilitates student collaboration. Date accessed: 09.06.2021. [Online]. Available: [https://github.com/student-hub/paper/blob/master/Design\\_and\\_implementation\\_of\\_a\\_cross\\_platform\\_mobile\\_application\\_that\\_facilitates\\_student\\_collaboration.pdf](https://github.com/student-hub/paper/blob/master/Design_and_implementation_of_a_cross_platform_mobile_application_that_facilitates_student_collaboration.pdf)
- [5] Sheen. Review vs feedback vs testimonial. Date accessed: 27.06.2021. [Online]. Available: <https://www.reviewadda.com/institute/article/158/review-vs-feedback-vs-testimonial>
- [6] B. Gates. (2013, May) Teachers need real feedback. Date accessed: 21.06.2021. [Online]. Available: [https://www.ted.com/talks/bill\\_gates\\_teachers\\_need\\_real\\_feedback](https://www.ted.com/talks/bill_gates_teachers_need_real_feedback)
- [7] O. Hasan, L. Brunie, and E. Bertino, "Preserving privacy of feedback providers in decentralized reputation systems," *Computers & Security*. Avail-



- able: <https://doi.org/10.1016/j.cose.2011.12.003>, vol. 31, no. 7, pp. 816–826, 2012, iFIP/SEC 2010 "Security & Privacy – Silver Linings in the Cloud".
- [8] A. Rowe, "The personal dimension in teaching: why students value feedback," *International Journal of Educational Management*. Available: <http://dx.doi.org/10.1108/09513541111136630>, vol. 25, no. 4, pp. 343–360, May 2011.
- [9] M. P. Clynes and S. E. Raftery, "Feedback: An essential element of student learning in clinical practice," *Nurse Education in Practice*, vol. 8, pp. 405–411, 2008.
- [10] M. Husain and S. Khan, "Students' feedback: An effective tool in teachers' evaluation system," *International Journal of Applied and Basic Medical Research*, vol. 6, pp. 178–181, 2016.
- [11] E. Ruberto. How to use a customer feedback database to turn insights into action. Date accessed: 26.06.2021. [Online]. Available: <https://zapier.com/blog/ux-customer-feedback-database/>
- [12] R. I. (2021) Consiliul național al elevilor propune ministerului educației un mecanism de feedback semestrial față de activitatea profesorilor. Date accessed: 21.06.2021. [Online]. Available: <https://www.hotnews.ro/stiri-educatie-24745331-consiliul-national-elevilor-propune-ministerului-educatiei-mecanism-feedback-semestrial-fata-activitatea-profesorilor.htm>
- [13] R. EduPedu. O aplicație care permite profesorilor să primească feedback anonim de la elevi, teleskop, a fost actualizată. fondatorii: 10.000 de completări până acum. Date accessed: 29.06.2021. [Online]. Available: <https://www.edupedu.ro/o-aplicatie-care-permite-profesorilor-sa-primeasca-feedback-anonim-de-la-elevi-teleskop-a-fost-actualizata-fondatorii-10-000-de-completari-pana-acum/>
- [14] W. Brian Arthur, *The Nature of Technology: What It Is and How It Evolves*. Free Press, August 2009.
- [15] S. Laboratory. (2020) Anunțuri. Date accessed: 21.06.2021. [Online]. Available: <https://ocw.cs.pub.ro/courses/so/meta/anunturi?rev=1598446962>

- [16] N. Kuzmin, K. Ignatiev, and D. Grafov, "Experience of developing a mobile application using flutter," *Information Science and Applications*. Available: [https://doi.org/10.1007/978-981-15-1465-4\\_56](https://doi.org/10.1007/978-981-15-1465-4_56), vol. 621, pp. 571–575, 2020.
- [17] M. J. Roszkowski and A. G. Bean, "Believe it or not! longer questionnaires have lower response rates," *Journal of Business and Psychology*. Available: <https://doi.org/10.1007/BF01013611>, vol. 4, no. 4, pp. 495–509, June 1990.
- [18] U. Reja, K. Manfreda, V. Hlebec, and V. Vehovar, "Open-ended vs. close-ended questions in web questionnaires," *Adv Methodol Stats*, vol. 19, January 2003.
- [19] U. of Wisconsin-Madison. Best practices and sample questions for course evaluation surveys. Date accessed: 27.06.2021. [Online]. Available: <https://assessment.provost.wisc.edu/best-practices-and-sample-questions-for-course-evaluation-surveys/>
- [20] N. Z. b. Ayob, A. R. C. Hussin, and H. M. Dahlan, "Three layers design guideline for mobile application," in *2009 International Conference on Information Management and Engineering*, 2009, pp. 427–431.
- [21] C. Dichev and D. Dicheva, "Gamifying education: what is known, what is believed and what remains uncertain: a critical review," *International Journal of Educational Technology in Higher Education*. Available: <https://doi.org/10.1186/s41239-017-0042-5>, vol. 14, February 2017.