Project Design and Management for Data Science

Final report

by
I Just Wanna Design

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Contents

Chapter 1 - User need identification

1.1 - Introduction

The aim of the first chapter is to **identify users and their needs**, in the field of education.
In the following sections, we will describe the methods used and display the results.

1.2 - Methods

Figure 1 shows a flow chart summarising the stages executed in this phase, their inputs and outputs.
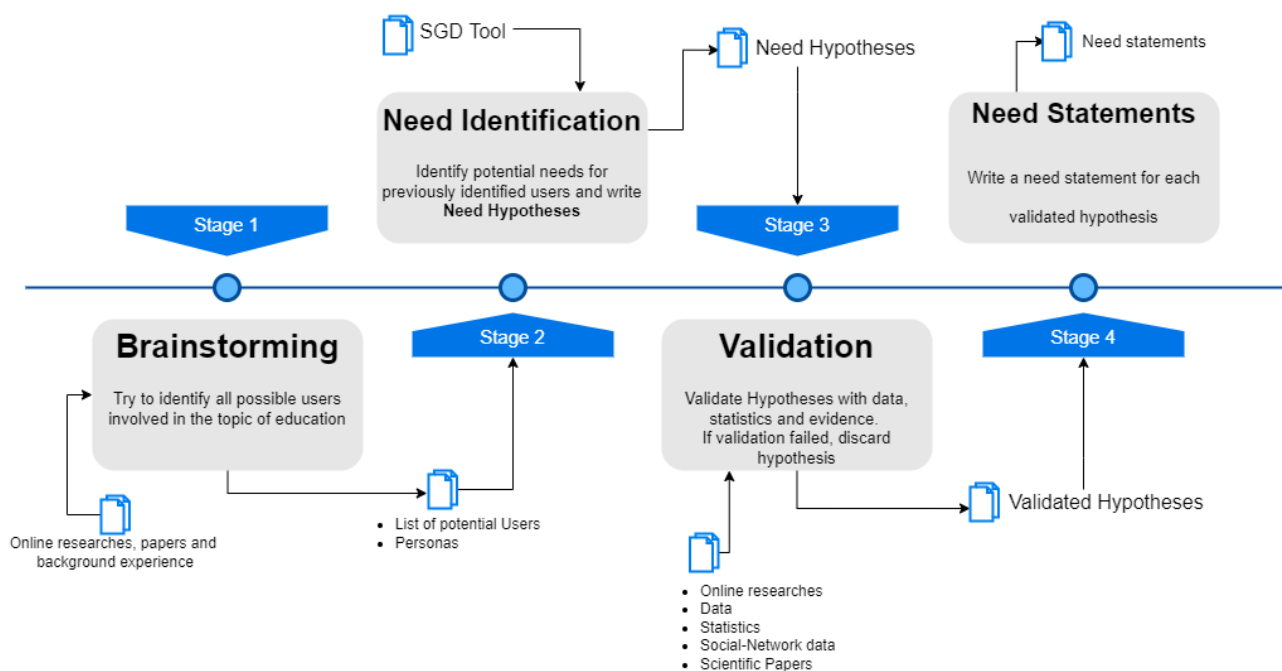
Figure 1: Macro sections in Users and Needs Identification phase

1.2.1 - User identification

In order to identify users, the following methods were used:

Brainstorming

As a first step, the team had a Brainstorming session in order to find a series of categories of individuals and more specific sub-individuals, directly or indirectly linked to the field of education. The team considered users from different **fields of education** and different **social and economic contexts.** Most of them are different kinds of students, because they are the type of users the team had the biggest amount of experience on, and they are the ones influenced the most by the education system. Afterwards, the list has been corrected and pruned based on the team's knowledge regarding the users and considering users more inherent to the world of education.

Personas

For each of the selected sub-users, the team used the **Personas** method, in order to empathize better with each potential user. This profiling technique consists in showing a fictitious example of each user, with realistic and well-defined goals, motivations, frustrations, personality, and lifestyle (*Persona Method - an Overview | ScienceDirect Topics*, n.d.).

To generate Personas, the team:
1. searched for **data** in scientific articles, supporting the ideas about each user. The information used comes from research online (articles, statistics)
2. used an online tool, called "**Uxpressia**" to create a visual representation (an example is shown in **Figure 2**)

Figure 2: Personas template used from the website Uxpressia. Each section must be filled with information like skills, possible goals, background, frustrations and motivations, channels used to communicate and available technologies

1.2.2 - Needs identification

Once users had been identified, we started generating needs. To create concrete needs for the selected users, the **Sustainable Development Goals** have been used: a set of 17 interconnected goals, defined by the United Nations, with the purpose of obtaining a better and more sustainable future for everyone.

Figure 3: Sustainable Development Goals

To identify a potential list of needs, each user has been mapped in the **SDG table** (**Table 1**). For each SDG and each user, the related grid space was filled with a potential need idea.

	No poverty	*Zero Hunger*	*Good-health and well-being*	*Quality education*	*Gender equality*	*…*
User 1						
User …						
User N						

Table 1. SDG table to fill with potential need ideas

Note that not all the 17 SDGs have been taken into consideration: after a preliminar brainstorming phase, the team found some columns to be less helpful for generating ideas connected with the world of education. For this reason, and to reduce the dimensionality of the problem, only some of the most meaningful columns (8) were selected, facilitating the contextualization of each user in the connection between education and the goal themself. To generate Need Hypotheses the team used the following structure:

- *we believe that the user* (informed guess of a user's behavior)
- *so, if we* (something that we want the user to do)
- *then* (expected result or a measure of success)

For each hypothesis, **research** was conducted (mainly online looking for statistics, scientific reports, and trends) with the aim of verifying their actual correspondence with a real need. Once Need Hypotheses were made, each of them has been evaluated through **quantitative** research (**social**

media, **academic research papers**, **official statistics**, **web articles**). In case no data could prove that the need hypotheses represented real needs, then they would be discarded. The next step was writing down the verified hypotheses in the form of Need Statements, structured in this way:

1. *[A user]*
2. **Needs** [*need*]
3. **In order to** [*goal*]

1.3 - Results

In this section are reported the results of the described methods' applications to our case, with some examples and explanations of our decisions.

1.3.1 - User Identification

Table2 shows the first list of users generated through the Brainstorming session:

USER	SUB-USER
STUDENTS	Offsite, Commuters, Workers, Parents, Outsourcing, In progress, Freshmen, With Handicap, Foreigners, PHD Students, Care Givers, Trainees
PARENTS	Unemployed, with economic difficulties, single, with handicap, workers
TEACHERS	Researchers, Commuters, Care Givers, Permanent, Associates
SERVICE / ADMINISTRATIVE STAFF	Canteen, Cleaning, Secretariat, Administration, ATA, Library
LOGISTICS STAFF	Procurement of automatic machines, toilets, teaching tools, books, canteens
DEALERS	Copy shops, newsstands
TRANSPORT STAFF	Trains, Airplanes, Buses
RENTALS	Private renters, real estate agencies
ONLINE PLATFORMS	Search books, e-learning, student services
SELF-TAUGHT	Autonomous learning (books, online)
EDUCATIONAL STRUCTURES	Physics (public, private, peer), Online (public, private, teaching courses)
INSTITUTIONS AND EDUCATIONAL STRUCTURES	Student committees, ministry of education, political parties, DSU
EXTERNAL COMPANIES	Recruiters, statisticians, companies affiliated with universities or colleges
UNIVERSITY	Erasmus projects, associated research, competitions
EMPLOYERS	industries, hotel sector
BIG COMPANIES	Tech sector, consultancy

Table 2: Brainstorming phase output, potential users table

1.3.2 - List of potential users

After pruning the initial list of potential users, we selected a restricted number of them, the ones we felt to be more closely connected with issues in the world of education.

Table 3 shows the twelve selected users:

POTENTIAL USERS		
Offsite Student	Worker Student	Recruiter /business entrepreneur
Erasmus student	Commuter Student	Parent with financial difficulties
Student with disabilities	Regular Student	Researcher teacher
Remote Student	Generic Teacher	Self-taught Student

Table 3: Potential Users list

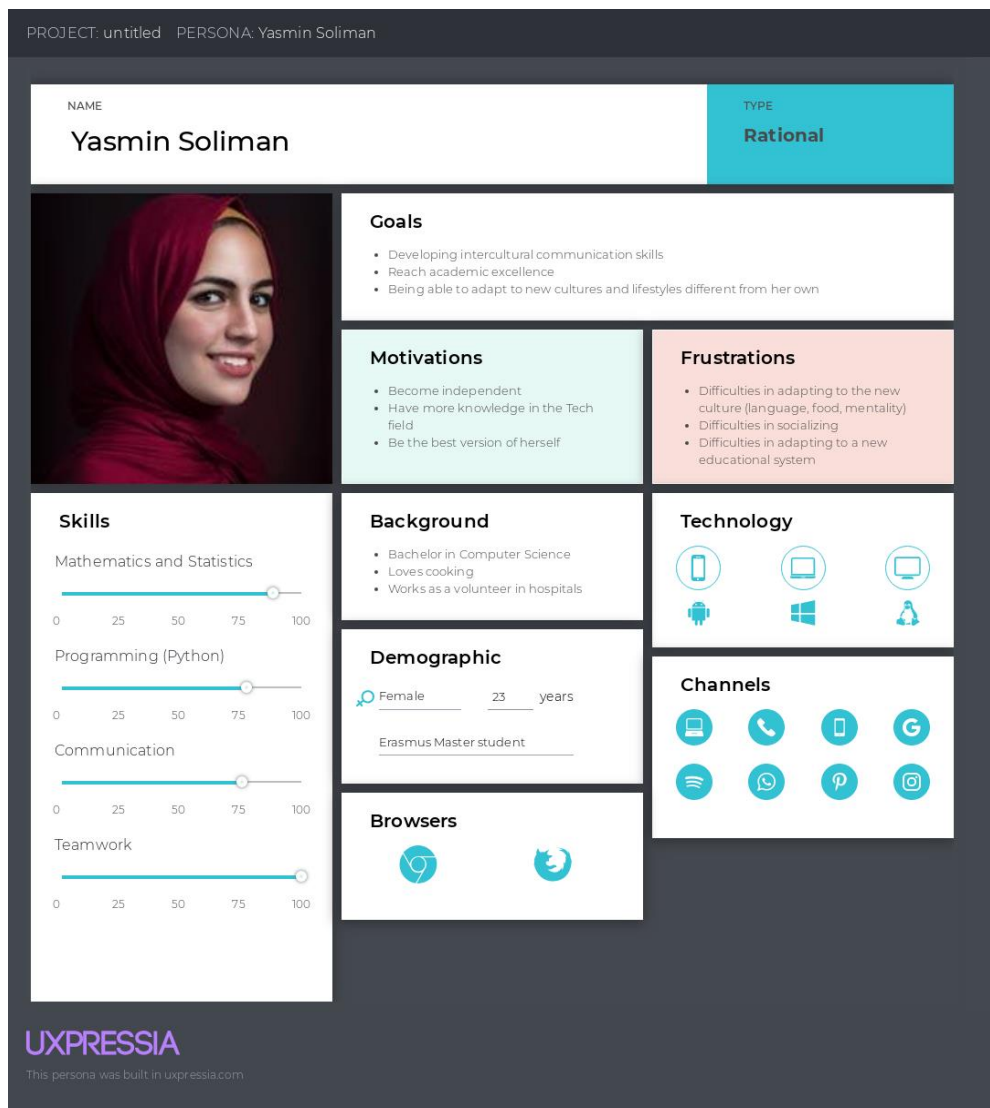### 1.3.3 - Personas

Figure 4 shows an example of "Persona":

Figure 4: Personas for the Erasmus student. Sources: (Chen et al., 2019),(Why Muslim College Students Need More Institutional Support, 2020, (Colleges Addressing Needs of Muslim Students, 2016).

1.3.4 - Needs Identification

Regarding the SGD table, we took into account the eight goals we considered to be more interesting for the analysis we were carrying on. The team tried to fill all the cells of the matrix, even though in some cases (e.g. *Sustainable cities and communities*), we were not able to define a relevant need. The following table shows the resulting **SGD table (Table 4)**:

	1 Quality education	2 Decent work and economic growth	3 Reduced inequalities	4 Good health and well-being	5 Industry, innovation and infrastructure	7 Sustainable cities and communities	8 Partnerships for the goals
Regular Student	effective job preparation during his career	obtain a stable, stimulating and rewarding job	have an education like other students of others institutes, in the same state or abroad	follow their studies without anxiety problems, stress due to educational rhythms	be part of a stimulating and rewarding educational context		get in touch with the world of work in a simple and effective way; get support from his educational background in doing so
Remote Student	effective and efficient work preparation despite the remote contact	have valid work skills and are not limited by their learning context	have equal educational opportunities compared to its counterpart in the presence	take advantage of distance learning without stress and psycho-physical problems due to this modality	being part of an inclusive educational context despite the distance, stimulating and rewarding		have equal opportunities for contact with the world of education and work compared to students in the presence
Parent with financial difficulties	guaranteeing a good education for children and avoiding early school leaving	find a good job to support the family	guarantee his children a good education, on a par with more well-to-do families	ensure medical care and good health for the family	contribute its skills to development	play its role as a citizen and parent to ensure a more sustainable community	communicate with multiple business bodies efficiently
Working Student	effective job preparation during his career	effective education for finding a better job	same opportunities as their full-time colleagues	include study time in their work-life balance in an healthy way			
Manager / Recruiter	recruit graduate students already prepared for the business standards	helped by their companies in a constant journey to improve their skills	being able to choose from a multicultural pool of young professionals	learn more about how to deal with stress and how to achieve a good work-life balance	improve the innovative capabilities of their company collaborating with education		form stronger collaborations with universities, researchers and students
Erasmus Student	Need to have equal access to education as their peers in the new education system	Need to be competitive in the market	Need to have an opportunity to communicate to their peers and not isolate themselves, for example linguistic support	Need to be safe in the new environment, so access to essential healthcare services		Need to feel comfortable with new education systems, therefore they need an appropriate accommodation that can provide a place to stay, food.	Students with economic difficulties need associations that can make funding programs for

							Erasmus students
University Professor	Need to modernize and adapt to new methods of teaching and learning	Need to be trained properly in order to be competitive					
Off-site student	Need to receive a good education, that does not make useless the moves in another city	Would enter soon in the job world in order to help her parents with costs for her suististance	Have a good preparation equals to her colleagues	Would have an optimistic and productive soul to study and don't feel sad or depressed	hopes that technological progress will allow her to enter in a stimulating work environment		Have contact with different realities and cultures

Table 4: Table of users and SDGs

1.3.5 - *Need Hypotheses:*

Table 5 shows examples of the Need Hypotheses generated formalising all the potential needs shown in Table 4:

Users	Need Hypothesis
Regular Student	**REDUCE INEQUALITIES | QUALITY EDUCATION** ● *we believe* that students are prepared in a qualitatively different way according to the institution and the country they belong to ● *so, if we* conduct an analysis on the preparation quality of the students ● *then* we will find that there is a difference in the preparation provided
Off-site student	**GOOD EDUCATION |DECENT WORK AND ECONOMIC GROWTH | REDUCE THE INEQUALITIES** ● *We believe that* an off-site student study in another city would like to have more job opportunities ● *So, if we* consult statistics about the occupation rate based on the different university of the country ● *then we* would see differences in the graduated salary and opportunities
Erasmus Student	**SUSTAINABLE CITIES AND COMMUNITIES** ● *we believe* that Erasmus students should feel comfortable in the new country and with the new accommodation ● *so, if we* look at articles regarding this topic ● *then we* will see a positive response
Recruiter / Manager in the Tech Sector	**REDUCED INEQUALITIES** ● *we believe tha*t Companies would benefit from being able to choose from a multicultural pool of young professionals ● *so, if we* search for academic publications regarding this topic

	• *then we* would see that the benefits of multicultural teams have been analyzed by many scholars and experts
Parent with economic difficulties	**GOOD HEALTH - WELL BEING	QUALITY EDUCATION** • *We believe* that early education leaving is also determined by economic difficulties of families • *so, if we* look for some sources about it • *we would* see how the two factors are related

Table 5: Example of need hypotheses for different users, according to the SDG goal.

Not every need hypothesis could be validated with enough data, or the need itself was too general to perform specific quantitative research. This led the team to the **elimination of some hypotheses** and in some cases, of some users altogether, for which we could not validate any hypothesis. For each one that was confirmed by reliable data, a need statement was generated.

For **example**, in order to test the hypothesis for the parents with economic difficulties**,** research on statistical data was conducted. It emerged that in the municipalities where family distress is more widespread (over one in 10 families are in potential economic hardship), school dropouts are more frequent, such that almost all municipalities (98.18%) have a share of early exits from the education system. On the contrary, in the municipalities where the share of families in need is more contained (1 out of 10), the municipalities with a high abandonment rate drop to 37.15%. This data demonstrates that the hypothesis holds and is, therefore, a candidate to be reformulated in a need statement.
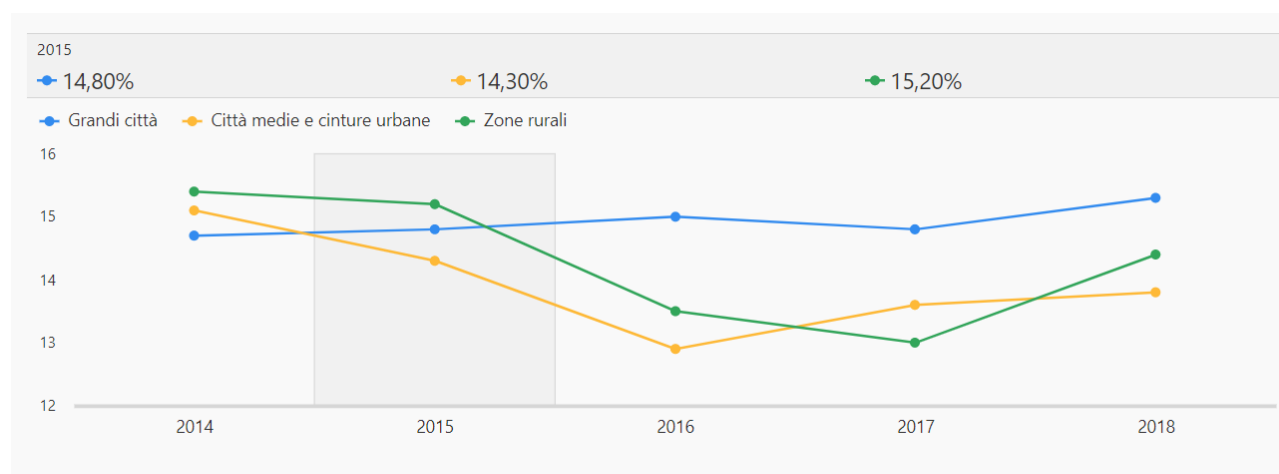
Figure 5: Example of research conducted to validate need hypothesis:
School Dropout Rate for municipalities category (Openpolis. n.d. La crescita dell'abbandono scolastico nelle città)

1.3.6 - Need statements
The need statements list reflects problems of economic, psychological, and functional nature. Many of them arise from the systemic limits of the actual educational system, but there are also needs caused by the recent social changes, like the COVID-19 Pandemic or the economic crisis, that affected the education world.
The team tried to focus also on needs related to occupation prospects, strongly felt by students, especially at the end of their studies.
The following list shows the final output of this first phase, with need statements related to each potential user identified.

Students

- Need to follow a less stressful and pressing educational path in order to pursue their goals with better results and less risk of dropping out.
- Need to have a quality educational path regardless of the place of learning, in order to have a valid preparation for their future jobs.
- Need more educational initiatives in favour of the environment, with the aim of improving their lifestyle and safeguarding the future of their generation.
- Need to be able to find appropriate spaces and infrastructures, like libraries and capacious study areas, drinking fountains, power outlets, adequate heating, and cooling systems, places to eat, etc, in order to be able to stay away from home all day and still be comfortable and productive.
- Need to receive an education that is effective in preparing them for the jobs they aspire to, and that teaches them useful skills which are requested from the labour market, in order to increase their employability right after graduating.

Parents and students

- Need less financial pressure in order to ensure a complete educational path and to avoid school dropouts.

Remote Students

- Need better organized and efficient distance learning, with the aim of having a quality education despite the distance from the place of learning.

Working Students

- Need to be provided with clear and comprehensive study material and helpful professors available for clarifications outside of lesson hours, in order to have the same learning opportunities as their full-time colleagues.
- Need to learn how to be able to include study time in their work-life balance in a healthy way, in order to avoid any psychological problems that are common when studying and working at the same time.

Off-site students

- Need to find a temporary job, compatible with the study hour, in order to make himself/herself to sustain the costs of living far from home.
- Feels the need to move on to receive a better education and more work opportunities.

Erasmus students

- Need to have equal access to education as their peers in the new education system, in order to reach their potential as students.
- Need quality education in order to be competitive in the market.
- Need to communicate to their peers in order to not isolate themselves, for example, linguistic support
- Need to access to essential healthcare services in order to be safe in the new environment
- Need to feel comfortable with new education systems, therefore they need an appropriate accommodation that can provide a place to stay, food.

- with economic difficulties need associations that can make funding programs for Erasmus students
- Need of associations and partnerships with more universities in order to have more foundations for Erasmus exchanges.

University professors

- Need to modernize and adapt to new methods of teaching and learning in order to reach all students with different backgrounds and mentalities
- Need to be trained properly in order to be competitive

Recruiters/Managers

- Need graduate students to be already prepared for the business standards, both in technical skills and in soft skills, in order to spend fewer resources in training them.
- Need to be helped by their companies in a constant journey to improve their skills, and to be rewarded for their efforts, in order to be prepared to face increasingly harder challenges and increase their overall worth.
- Need to be able to choose from a multicultural pool of young professionals, in order to create diverse teams in which creativity is fostered.
- Need to learn more about how to deal with stress and how to achieve a good work-life balance, especially in this post-pandemic period, in order to preserve their health while working in such a competitive field and such stressful times
- Need to form strong collaborations with universities, researchers, and students, in order to improve their performances and scout for promising graduates, while helping the education system adapt its programs to better fit the needs of the labour market

Chapter 2 - User Needs Assessment: Rank and Decision

2.1 - Introduction

In this second part of our project, we will discuss the **assessment** of the need statements formulated in the previous chapter.

2.2 - Methods

We organized this part of the project in the following **steps (Figure 6)**:
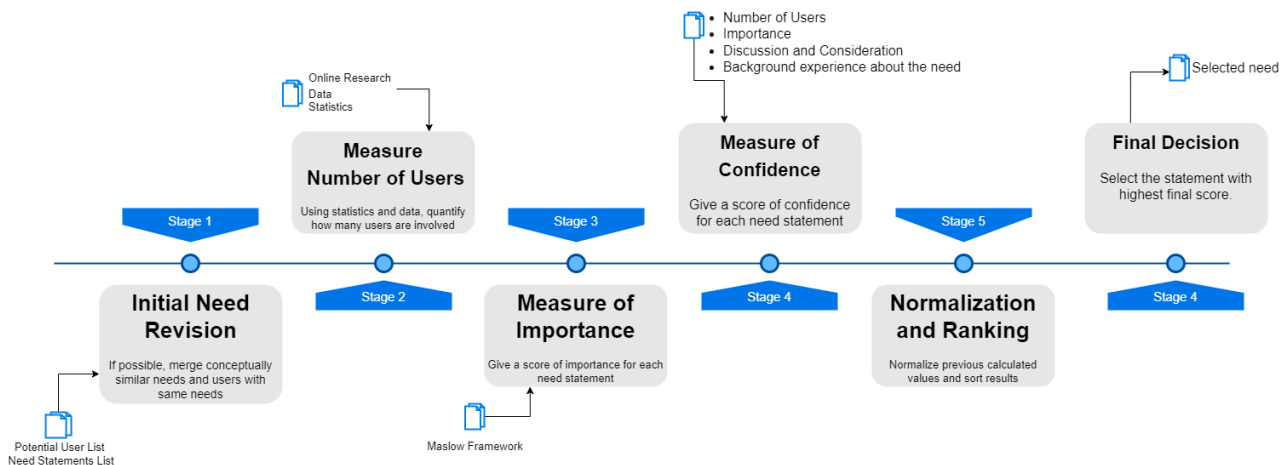
Figure 6: Flow of operations performed in Need Assessment Phase

2.2.1 - Initial Needs Revision

Starting from the need statements list, an initial revision has been performed to check the quality of this starting point:

1. **Analyze need statements**
   The first step consisted in evaluating the need statements we produced in the previous user needs report
2. **Merge conceptually similar needs**
   The team realized that some of the needs could be merged together since they were conceptually similar.
3. **Aggregate users with the same needs**
   Merges were made also for different potential users, in case they share a similar set needs. This can be common when some users are different specifications of the same macro-user category (e.g. students of various kinds)

2.2.2 - Measurement of the number of users

During the second step, we measured the number of users. In order to quantify them, for each user the team *researched* **online** using scientific papers, articles, and official statistics as sources and *quantified* users using results from such research.

For some statements, quantifying properly the number of users was quite difficult. To manage this situation, the team **revised again** the need statements, considering a more general number of users.

2.2.3 - Measure of the importance

The team measured the **importance** of the need statements with Maslow's framework, a motivational model of human development based on a hierarchy of needs, arranged in a pyramid, according to which the satisfaction of the most basic needs is a necessary condition for the emergence of those of a higher order.

- **Assign ranks to Maslow's Framework pyramid levels**

We assigned a number to each level of the framework in a range from 1 to 5, from least important (higher in the pyramid) to most important (lower in the pyramid) (**Figure 7**).
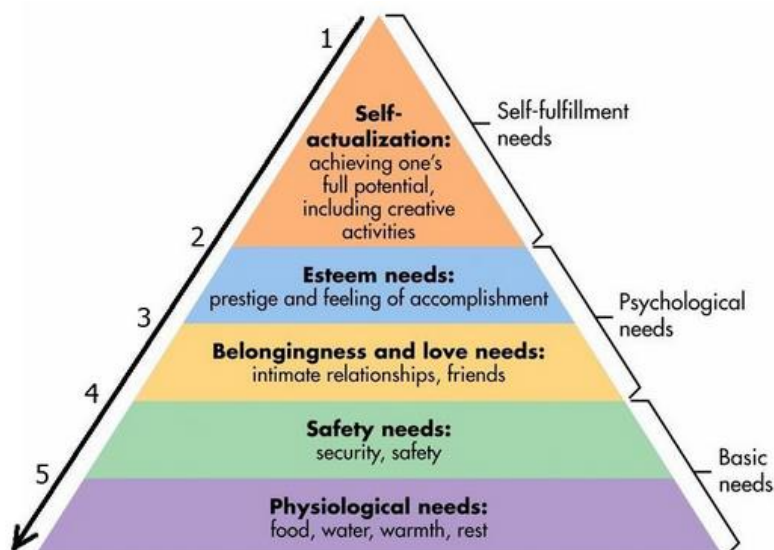
Figure 7: Maslow's Framework Ranking. Maslow's framework represents a hierarchy of human needs, here we assign a number to each level of the pyramid.

- **Assign statement to one or more levels of the pyramid and their related score**

In order to classify statements and understand which ones are more impactful than others, the team assigned them to one or more of the pyramid levels. In case a need did not fully correspond to a specific level, the team discussed it and considered the average between the levels we thought were more representative of the need. Due to the averaging process, the final score is not always an integer and as such does not always correspond to a specific level of the pyramid.

Furthermore, in case of disagreements between the members of the group, we made additional research online, with the purpose of assigning the most accurate score to each statement.

2.2.4 - Measure of confidence

To measure confidence, we had to quantify how sure we were about the values and numbers assigned to the *number of users* and *importance* of all the needs in the previous steps.

Therefore, each team member assigned a confidence vote in the range [0-1] to every need statement. The final value of confidence for each statement is the average between our assigned scores.

At the end of this process, Number of Users, Importance and Confidence values were inserted in a table structured like **Table 6**:

	Number of users	Importance	Confidence
Need 1			
...			
Need n			

Table 6: Table format for measurement of the number of users, importance and confidence

2.2.5 - Normalization and ranking

In order to create a ranking between all the need statements, the team:

- normalized the values of the columns relative to the Number of Users and the Importance in a range [0-1], applying the following formula:

$$Normalized\ Value = \frac{value - min(values)}{max(values) - min(values)} + 0.1$$

   The addition of 0.1 at the end has the purpose of avoiding a value equal to zero for the minimum value in each column.

- Calculated the final score using the following formula:

$$Final\ Score = (Number\ of\ Users) \cdot (Importance) \cdot (Confidence)$$

- Sorted the table by Final Score, in decreasing order.

	Norm N of users	Importance	Confidence	Final Score
1st Need				
2nd Need				
3rd Need				

Table 7: Table format for the measurement of final score

2.2.6 - Final decision:

Especially in case of close final scores for the top ranked needs, the final decision has not to be bound only by the final score: an additional discussion session between the team members is advised, in order to select a need that is also interesting to carry on with respect to the scope of the project.

2.3 - Results

2.3.1 - Initial needs revision results
Table 8 shows the merge of similar needs from the statement list.
In some cases, where quantitative information about users was not available, we also grouped together needs pertaining to similar groups of users or redefined their users, to be able to quantify them in a better way.

From	Into
Students → Need to have a quality educational path regardless of the place of learning, in order to have a valid preparation for their future jobs **Students →** Need to receive an education that is effective in preparing them for the jobs they aspire to, and that teaches them useful skills which are requested from the labor market, in order to increase their employability right after graduating.	**Students →** Need to receive an education that is effective in preparing them for the jobs they aspire to, and that teaches them useful skills which are requested from the labour market, in order to increase their employability right after graduating.
Remote students → Need better organized and efficient distance learning, with the aim of having a quality education despite the distance from the place of learning **Working students →** Need to be provided with clear and comprehensive study material and	**Remote and working students →** Need to be provided with better organized learning, clear and comprehensive study material and helpful professors available for clarifications outside of lessons hours, in order to have the

helpful professors available for clarifications outside of lesson hours, in order to have the same learning opportunities as their full-time colleagues.	same learning opportunities as their full-time colleagues
Erasmus students → Need to have equal access to education as their peers in the new education system, in order to reach their potential as students **Erasmus students →** Need quality education in order to be competitive in the market	**Erasmus students →** Need to have equal access to education as their peers in the new education system, in order to reach their potential as students
Recruiters/Managers → Need graduate students to be already prepared for the business standards, both in technical skills and in soft skills, in order to spend less resources in training them. **Recruiters/Managers →** Need to form strong collaborations with universities, researchers and students, in order to improve their performances and scout for promising graduates, while helping the education system adapt its programs to better fit the needs of the labor market	**Companies →** Need to form strong collaborations with universities, researchers and students, in order to improve their performances and scout for promising graduates, while helping the education system adapt its programs to better fit the needs of the labor market

Table 8: Merged Needs. In this table, we display which needs have been merged together because they were conceptually similar.

After this revision we obtained the final list of needs statements to assess, shown in **Table 9**:

Need ID	Need Statement
1	**Students →** Need to follow a less stressful and pressing educational path in order to pursue their goals with better results and less risk of dropping out
2	**Students →** Need more educational initiatives in favor of the environment, with the aim of improving their lifestyle and safeguarding the future of their generation
3	**Students →** Need to be able to find inclusive and appropriate spaces and infrastructures, like libraries and capacious study areas, drinking fountains, power outlets, adequate heating and cooling systems, places to eat etc, in order to be able to be comfortable and productive on campus
4	**Students →** Need to receive an education that is effective in preparing them for the jobs they aspire to, and that teaches them useful skills which are requested from the labor market, in order to increase their employability right after graduating.
5	**Students →** Need less financial pressure in order to ensure a complete educational path and to avoid school dropout
6	**Remote and Working Students →** Need to be provided with better organized learning, clear and comprehensive study material and helpful professors available for clarifications outside of lessons hours, in order to have the same learning opportunities as their full-time colleagues

7	**Working Students** → Need to learn how to be able to include study time in their work-life balance in a healthy way, in order to avoid many psychological problems that are common when studying and working at the same time.
8	**Off-site students** → Need to find a temporary job, compatible with the study hour, in order to make himself/herself to sustain the costs of living far from home
9	**Off-site students** → Feels the need to move on to receive a better education and more work opportunities
10	**Erasmus student** → Need to have equal access to education as their peers in the new education system, in order to reach their potential as students
11	**Erasmus student** → Need to communicate to their peers in order to not isolate themselves, for example, linguistic support
12	**Erasmus student** → Need to access to essential healthcare services in order to be safe in the new environment
13	**Erasmus student** → with economic difficulties need associations that can make funding programs for Erasmus students
14	**Erasmus student** → Need of associations and partnerships with more universities in order to have more foundations for Erasmus exchanges.
15	**University professors** → Need to modernize and adapt to new methods of teaching and learning in order to reach all students with different backgrounds and mentalities
16	**Employees in the ICT Field** → Need to be helped by their companies in a constant journey to improve their skills, and to be rewarded for their efforts, in order to be prepared to face increasingly harder challenges and increase their overall worth.
17	**Companies in the ICT Field** → Need to be able to choose from a multicultural pool of young professionals, in order to create diverse teams in which creativity is fostered.
18	**Employees in the ICT Field** → Need to learn more about how to deal with stress and how to achieve a good work-life balance, especially in this post-pandemic period, in order to preserve their health while working in such a competitive field and such stressful times
19	**Companies in the ICT Field** → Need to form strong collaborations with universities, researchers and students, in order to improve their performances and scout for promising graduates, while helping the education system adapt its programs to better fit the needs of the labor market

Table 9: Table with the final need statements to assess, obtained after merging and modifying some of the need statements from the results of the previous phase

2.3.2 - Measurement of the number of users

To estimate the number of users, we considered demographic data and statistics, in order to give a more realistic representation of our target.

In case of needs defined with a user for which appropriate data could not be found, the team **revised again** the need statements, considering a more general number of users. In particular:

- Data on the number of "remote students" in this post-pandemic period is variable and discordant: as such, we removed them from the statement about *Remote and Working Students.*

- For the statements regarding the labor market for graduates (where the users were *Companies* and their employees), we decided to focus only on the ICT sector, since it is the one closest to us and about which we have more information.

Table 10 shows the quantification of our potential users.

User	Number	Sources
Students	1.793.000	USTAT 20/21
Remote* / Working Students	233.000	EUROSTAT
Off-Site Students	592.000	CORRIERE.IT
Erasmus Students	192.000	EUROPA.EU / INDIRE.IT
University Professors	100.000	USTAT 20/21
Companies & Employees (ICT)	558.000	EUROSTAT

Table 10: User Quantification. This table displays the number of users and the sources where we found the data. The number on the right of each source represents the reference.

2.3.3 - Measure of importance

The measure of the importance of needs derives from one of the following cases:

- a **perfect correspondence** of the level of the Maslow pyramid;
- an **average** between the levels that we thought were more representative.

Need Statement	Importance	Motivation
Students → Need to follow a less stressful and pressing educational path in order to pursue their goals with better results and less risk of dropping out	3.75	Between Psychological ([3+2]/2 = 2.5) and Physiological (5)
University Professor → Need to modernize and adapt to new methods of teaching and learning in order to reach all students with different backgrounds and mentalities	2	Esteem Needs (2)
Erasmus Students → Need to communicate to their peers in order to not isolate themselves, for example, linguistic support	3	Belongingness (3)

Table 11: Example of importance scoring with specific motivation for the assignment

2.3.4 - Measure of confidence

Table 12 shows three examples of Confidence voting given by the team. The full votes can be found in table 13 instead.

Need ID	Confidence Votes	Confidence Final (average)
1	0.5+0.75+0.7+0.55	0.625
2	0.35+0.2+0.3+0.6	0.275
3	0.4+0.5+0.7+0.8	0.45

Table 12: The table above represents the confidence evaluation measurement, and it shows three examples. The confidence level was given by each of us with a score from 0.1 to 1. The final confidence value is the result of the average of the confidence votes.

2.3.5 - Need Assessment table

Table 13 contains values assigned by the group to number of users, importance and confidence:

Need ID	N. of Users	Importance	Confidence Votes
1	1.793.000	3.75	0.5+0.75+0.7+0.55
2	1.793.000	4	0.35+0.2+0.3+0.6
3	1.793.000	4.5	0.4+0.5+0.7+0.8
4	1.793.000	3.25	0.85+0.85+0.6+0.9
5	1.793.000	4	0.25+0.20+0.3+0.6
6	233.000	2.5	0.85+0.9+0.7+0.9
7	233.000	3.5	0.4+0.5+0.35+0.6
8	592.000	3.5	0.45+0.25+0.6+0.6
9	592.000	2	0.65+0.75+0.8+0.6
10	192.000	1.5	0.7+0.75+0.7+0.8
11	192.000	3	0.75+0.8+0.8+0.8
12	192.000	4.5	0.2+0.2+0.6+0.8
13	192.000	4	0.2+0.2+0.1+0.7
14	192.000	1.5	0.25+0.2+0.35+0.7
15	100.000	2	0.7+0.75+0.75+0.8
16	558.000	2	0.5+0.65+0.45+0.7
17	558.000	1.5	0.3+0.2+0.2+0.5
18	558.000	3.5	0.35+0.4+0.3+0.8
19	558.000	1.5	0.2+0.15+0.4+0.6

Table 13: Table with the final need statements assessed. The Need ID refers to Table 5, the Number of users from the sources referenced in Table 2, the Importance has been estimated with the help of Maslow's framework, and the Confidence columns show the values assigned by each team member, which will be averaged in the next step.

2.3.6 - Need Assessment table (normalized and sorted)

Table 14 contains final results of the process, normalized and sorted. An additional column has been added, containing the final score for each statement.

Need	N° of Users	Importance	Confidence	Total
4	1,00	0,60	0,85	0,51
1	1,00	0,75	0,63	0,47
3	1,00	0,90	0,45	0,41
2	1,00	0,80	0,28	0,22
5	1,00	0,80	0,23	0,18
9	0,28	0,40	0,70	0,08
18	0,27	0,70	0,38	0,07
8	0,28	0,65	0,35	0,06
16	0,27	0,40	0,58	0,06
6	0,08	0,50	0,88	0,04
11	0,06	0,60	0,78	0,03
7	0,08	0,70	0,45	0,03
17	0,27	0,30	0,25	0,02
19	0,27	0,30	0,18	0,01
10	0,06	0,30	0,73	0,01
12	0,06	0,90	0,20	0,01
13	0,06	0,80	0,20	0,01
15	0,02	0,40	0,73	0,01
14	0,06	0,30	0,25	0,01

Table 14: Table with the final need statements assessed, normalized and sorted. The columns regarding the Number of Users and the Importance have been normalized in [0-1], while the Confidence scores from Table 6 have been averaged. The Total column shows the product of the previous three.

2.3.7 - Final need decision

The user need statement, that we chose based on our output and decision making was the following one:

University Students → Need to receive an education that is effective in preparing them for the jobs they aspire to, and that teaches them useful skills which are requested from the labour market, in order to increase their employability right after graduating.

The final decision was not bound only by the final score. In fact, we also analyzed the second and third need statements and we felt that indeed the top ranked need was the one we felt to be more interesting to tackle, both from a personal perspective and from a Data Science one.

Chapter 3 - Project Management

3.1 - Introduction

In these first chapters of the report and in the following ones, the various design processes have been previously organized into **flows** of operations, with **time constraints**, **deadlines,** and division of **roles** among team members. Such an approach has been therefore schematized and proposed in the current chapter, for the first two phases of the process, through the use of techniques of **Project Management** such as **Flowcharts**, **Gantt Charts**, and **RACI Matrices**.

3.2 - Flowchart

Before schematizing the Flowchart relative to the two previous tasks, the team listed the **sequences of activities** performed, dividing them into sections. Related to the activities, we also added information about the **inputs and outputs** of each macro activity. The following list contains a brief description of each activity, formatted in a coding-like way, which will be useful for drawing the flowcharts without encountering ambiguities. The actual **flowcharts can be found after the schematized task lists** for the first two chapters.

Task 1 - User List and Need Statement Task List

1- **Brainstorming** (Output: Pruned list of potential users)
      1.1- Map the user space regarding education into a set of individuals and sub individuals
      1.2- Prune the list, based on:
- Team knowledge
- Vision of needs closer and more inherent to the world of education

2- **Personas method** (Input: Pruned list of potential users / Output: Personas)
      (For each potential user):
          2.1- Think about the general individuals in our list
          2.2- Find **data** supporting our ideas about that user (Output: DATA)
          2.3- (Input: DATA from 2.2) Generate more specific personas

3- **SDG tool** (Input: Pruned list of potential users + empty SDG table / Output: Potential need matrix)
      3.1- Select subset of columns of the SDG tool based on:
- Relevance to our users
- Relevance to the world of education in general

      3.2- *For each cell in the matrix*
          3.2.1- Try to come up with a potential need

4- **Need hypotheses** (Input: Potential need matrix / Output: Need Hypotheses)
      4.1 - *For each cell in the matrix that is not empty*
          4.1.1- Formulate a need hypotheses, generating:

- A test to prove/disprove it (preferably quantitative)
- Desired outcome for the test

4.2 - *For each need hypotheses*
- If no quantitative method to prove it is found:
  discard it

4.2.1- Make research and find data to prove them (Output: DATA)

4.2.2- (Input: DATA) Test hypotheses with data analysis
- If hypothesis not proved by data:
  discard it

5- **Need statements** (Input: Proved Need Hypotheses / Output: Need Statements)
5.1- *for each need hypotheses proved by data*
   5.1.1- write a need statement

6- **Make results and report** (Output: Report 1)

Task2 - User Need Assessment Task List

1- **Initial needs revision** (Input: List of need statements / Output: Revised list of need statements)
1.1- Analyze need statements
1.2- Merge conceptually similar needs (same objective)
1.3- Aggregate users with the same needs when we can

2- **Measurement of the number of users** (Input: Users from the need statements / Output: Quantified users)
2.1- *for each user*
   2.1.1- make research of data and statistics (O: DATA)
   2.1.1.1 - (I: DATA) Quantify users
   2.1.2- if user not quantifiable
      2.1.2.1- BACK TO 1.1: revise statements and users

3- **Measure of importance** (Input: Need Statement + Maslow Framework / Output: Importance scores)
3.1- Assign ranks to maslow's framework pyramid levels
3.2- *For each statement*
   3.2.1- assign statement to a maslow level and assign score
      3.2.2- if statement doesn't fall in single level
         3.2.2.1- map into multiple levels and do the mean

4- **Measure of confidence** (Input: Need Statement / Output: Confidence Scores)
4.1- *for each statement*
   4.1.1- for each member of the group
      4.1.1.1- Give a confidence vote to the statement, based on their perception of::
- Number of users

- Importance score

4.1.2- Make the mean of the votes

5- **Normalization and ranking** (Input: Assessment Table with Scores / Output: Ordered table)

5.1- Normalize values for number of users and importance in a range from 0 to 1

5.2- Calculate final score (Number of Users * Importance * Confidence)

5.3 - Order the table in decreasing order

6- **Final decision**

6.1- Take final decision looking at the final score and group member confidence

7 - **Write Report**

The following images (**Figure 8 and 9**) show the flowcharts we devised for describing our workflow for the first two parts of this project. External information/data and the various documents we produced have been represented by the document symbols, and integrated into the main flow with dashed lines, to show where they have been produced as output (by research, in case of data, or by our work, in case of documents) and where they have been used as input.

```
                          ┌─────────┐
                          │  START  │
                          └────┬────┘
                               │
List of potential users   ┌────┴─────┐
    ┌──────────┐◁ ─ ─ ─ ─ │ MAP THE  │
    │          │          │   USER   │
    └────┬─────┘          │  SPACE   │
         ┆                └────┬─────┘
         ┆                     │                    Pruned list of potential users
         ┆                ┌────┴─────┐              ┌──────────┐
         └ ─ ─ ─ ─ ─ ─ ─▷│ PRUNING  │─ ─ ─ ─ ─ ─ ▷ │          │
                         │   THE    │              └────┬─────┘
                         │   LIST   │                   ┆
                         └────┬─────┘                   ┆
                              │                         ┆
  Iterate over potential users│   ┌──────────┐          ┆
  ┌──────────────────────────┤FOR EACH│◁ ─ ─ ─ ─ ─ ─ ─ ─┘
  │                          │POTENTIAL│
  │                          │  USER   │
  │                          └────┬────┘
  │                               │
  │                          ┌────┴─────┐
  │                          │  THINK   │
  │                          │  ABOUT   │
  │                          │ GENERAL  │
  │                          │INDIVIDUALS│
  │                          └────┬─────┘
  │           Data                │
  │       ┌──────────┐       ┌────┴─────┐
  │       │          │◁ ─ ─ ─│FIND DATA │         Personas
  │       └────┬─────┘       └────┬─────┘      ┌──────────┐
  │            ┆                  │      ┌ ─ ─▷│          │
  │            ┆             ┌────┴─────┐│     └──────────┘
  │            └ ─ ─ ─ ─ ─ ▷│ GENERATE │┘
  └────────────────────────│ PERSONA  │
                           └────┬─────┘          SGD Tool Table
                                │              ┌──────────┐
                                │              │          │
                           ┌────┴─────┐        └────┬─────┘
                           │ SELECT   │◁ ─ ─ ─ ─ ─ ─┘
                           │SUBSET OF │◁ ─ ─ ─ ─ ─ ─ ─ ─ ─ ─ ─ ─ ─ ┘
                           │   SGD    │
                           │ COLUMNS  │
                           └────┬─────┘
 Iterate over SGD Matrix Cells  │   ┌──────────┐    Potential Need Matrix
 ┌─────────────────────────────┤FOR EACH │       ┌──────────┐
 │                             │ CELL IN │       │          │
 │                             │THE MATRIX│       └────┬─────┘
 │                             └────┬────┘            ┆
 │                                  │                 ┆
 │                             ┌────┴─────┐           ┆
 │                             │  WRITE   │  update   ┆
 │                             │POTENTIAL │─ ─ ─ ─ ─ ─┤
 └─────────────────────────────│  NEED   │
                               └────┬─────┘
 Iterate over SGD Matrix Cells      │   ┌──────────┐
 ┌──────────────────────────────────┤FOR EACH│◁ ─ ─ ─ ─ ─ ─ ─ ┘
 │                                  │ CELL IN │
 │                                  │THE MATRIX│
 │                                  └────┬────┘
 │                                       │
 │                     TRUE        ◇─────┴─────◇    FALSE
 │                  ┌──────────────│   CELL    │──────────┐
 │                  │              │ NOT NULL  │          │
 │                  │              ◇───────────◇          │
 │                  │                                     │
 │             ┌────┴─────┐                               │
 │             │  WRITE   │                               │
 │             │   NEED   │                               │
 │             │HYPOTHESIS│                               │
 │             │PROTOTYPE │                               │
 │             └────┬─────┘                               │
 │                  │                                     │
 │         TRUE   ◇─┴──────◇   FALSE                      │
 │        ┌───────│POSSIBLE│─────────┐                    │
 │        │       │   TO   │         │                    │
 │        │       │GENERATE│         │                    │
 │        │       │  TEST  │         │                    │
 │        │       ◇────────◇         │                    │
 │   ┌────┴─────┐              ┌─────┴────┐               │
 │   │  WRITE   │              │ DISCARD  │               │
 │   │   NEED   │              │HYPOTESIS │               │
 │   │HYPOTHESIS│              │PROTOTYPE │               │
 │   └────┬─────┘              └─────┬────┘               │
Need     │                          │                    │
Hypotheses│                         │                    │
┌────┐┌────┴─────┐                   │                    │
│    ││ UPDATE   │  update           │                    │
│    ││HYPOTHESES│─ ─ ─ ─            │                    │
└──△─┘│  LIST    │                   │                    │
   ┆  └────┬─────┘                   │                    │
   ┆       │                         │                    │
   ┆       └──────────────┬──────────┘                    │
   ┆                      │                               │
   ┆                      └───────────────┬───────────────┘
   ┆                                      │
   └ ─ ─ ─ ─ ─ ─ ─ ─ ─ ─ ─ ─ ─ ─ ─ ─ ─ ─ ┘
```
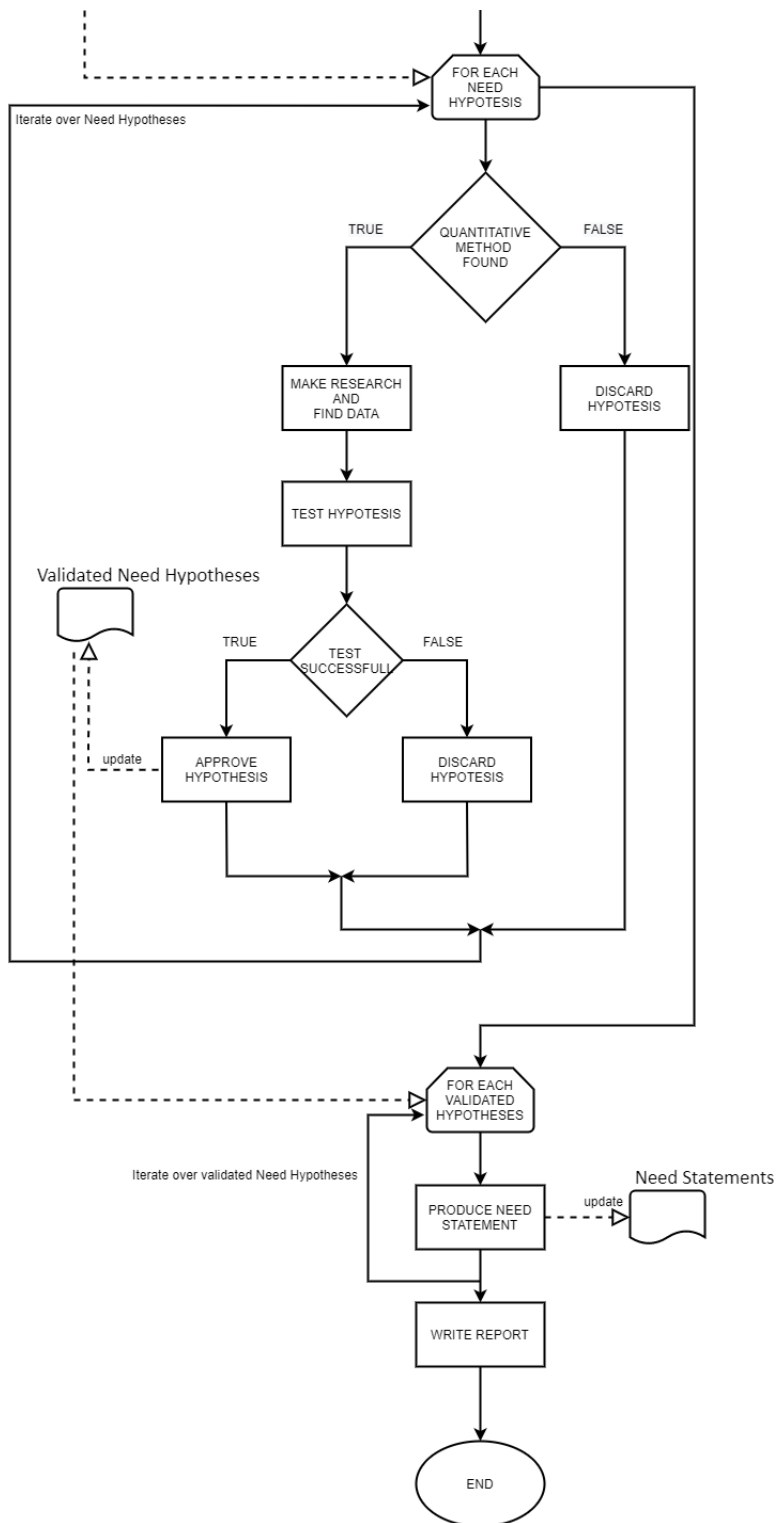
Figure 8: Flowchart for the first part of the project.

```
                           ┌──────────┐
                           │  START   │
                           └────┬─────┘
                                │
        Need                    ▼
      Statement           ┌──────────────┐
        List              │ Analyze Need │
     ┌─────────┐ ┄┄┄┄┄┄┄> │  Statements  │
     └─────────┘          └──────┬───────┘
                                 │                    Revised Need
                                 ▼                    Statement List
                          ┌──────────────┐  Update   ┌─────────┐
                          │ Merge similar│ ┄┄┄┄┄┄┄┄> └─────────┘
                          │ needs/ needs │
                          │ with similar │
                          │    users     │
                          └──────┬───────┘
                                 ▼
   Iterate of List of Users ┌──────────────┐
        ┌───────────────────│ For each user│<┄┄┄┄┄┄┄┄┄┄┄┄┄
        │                   │  in the need │
        │                   │statement list│
        │                   └──────┬───────┘
        │       User Data          ▼
        │     ┌─────────┐    ┌──────────────┐
        │     └─────────┘<┄┄┄│Make research │<───────────┐
        │          ┆         │ and find data│            │
        │          ┆         └──────┬───────┘            │
        │          ┆                ▼                    │
        │          ┆           ◇────────◇                │
        │          ┆     TRUE  │  Data   │ FALSE         │
        │          ┆      ┌─────│ found  │────┐          │
        │          ┆      │     ◇────────◇    │          │
        │          ┆      ▼               ▼              │
        │          ┆ ┌──────────┐  ┌──────────────┐ Go Back
        │          ┄>│ Quantify │  │ Revise need  │──────┘
        │            │   User   │  │statement/user│
        │            └────┬─────┘  │  definition  │
        │                 │        └──────┬───────┘
        │                 ▼               ▼
        └─────────────────┴───────────────┘
                          │
   ┄┄┄┄┄┄┄┄┄┄┄┄┄┄┄┄┄┄┄┄┄┄┄│
   ┆                      ▼                    Maslow's
   ┆                ┌──────────────┐           Framework
   ┆                │ Assign Values│          ┌─────────┐
   ┆                │ to each level│<┄┄┄┄┄┄┄┄┄ └─────────┘
   ┆                │  of Maslow's │
   ┆                │    Pyramid   │
   ┆                └──────┬───────┘
   ┆                       ▼            Iterate over List of
   ┆                ┌──────────────┐      Statements
   ┆                │ For each Need│<───────────────────┐
   ┆                │  Statement   │                    │
   ┆                └──────┬───────┘                    │
   ┆                       ▼                            │
   ┆                ┌──────────────┐                    │
   ┆                │ Evaluate it  │                    │
   ┆                │with Maslow's │                    │
   ┆                │  framework   │                    │
   ┆                └──────┬───────┘                    │
   ┆                       ▼                            │
   ┆                  ◇─────────◇                       │
   ┆          True    │Need fits │  False               │
   ┆           ┌──────│perfectly │──────┐               │
   ┆           │      │on a level│      │               │
   ┆           │      ◇─────────◇       │               │
   ┆           ▼                        ▼               │
   ┆   ┌──────────────┐        ┌──────────────┐         │
   ┆   │Map the State-│        │Map the State-│         │
   ┆   │ment to that  │        │ment on multi-│         │
   ┆   │level and as- │        │ple levels and│         │
   ┆   │ sign score   │        │assign the av-│         │
   ┆   └──────┬───────┘        │ erage score  │         │
   ┆          │                └──────┬───────┘         │
```

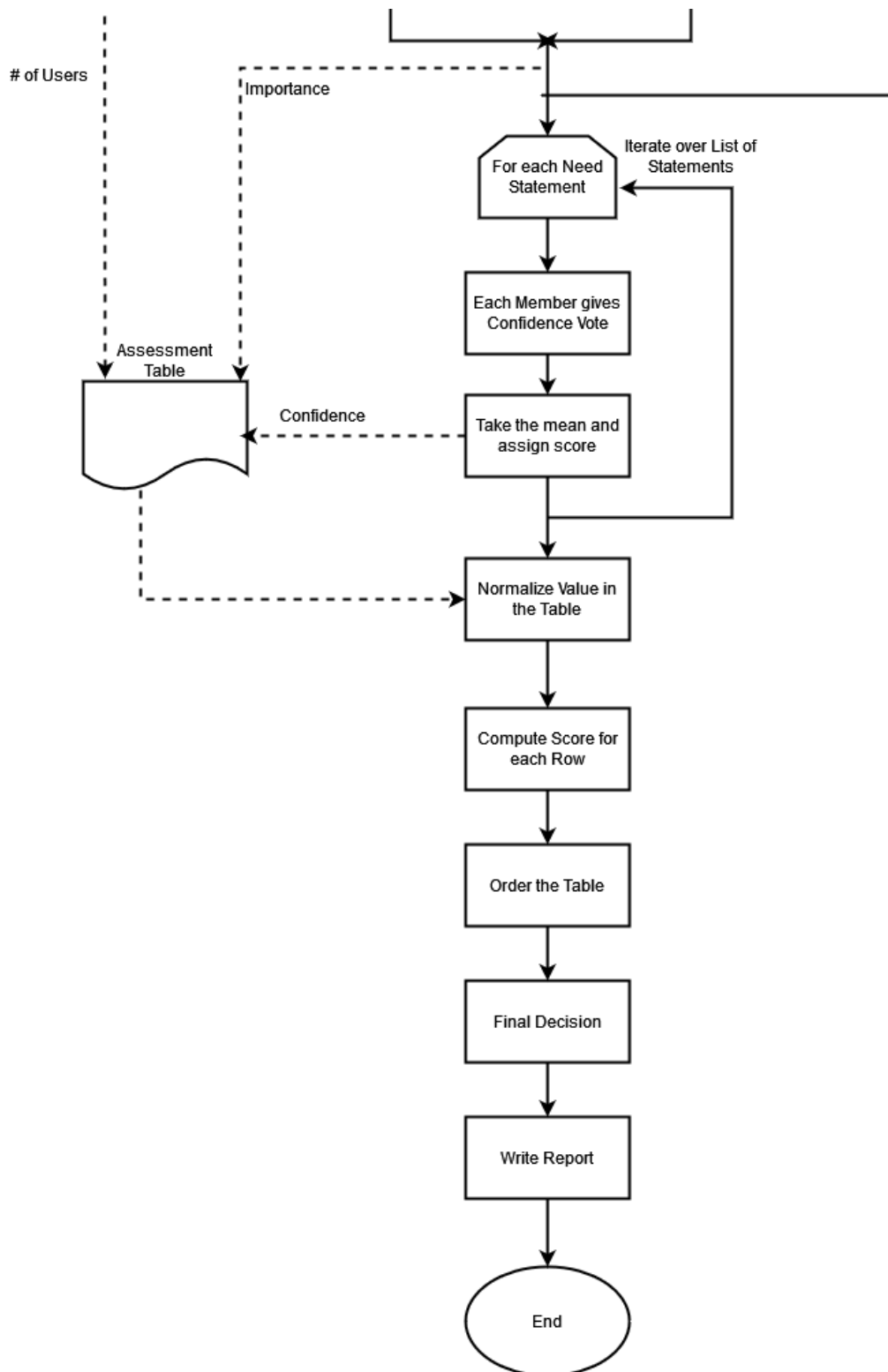*Figure 9: Flowchart for the second part of the project.*

3.3 - GANTT

For each macro activity in the list below and also for some relevant micro activity, we associated an **execution time**, with which we realized the GANTT charts, shown below (**Figure 10** and **Figure 11**).
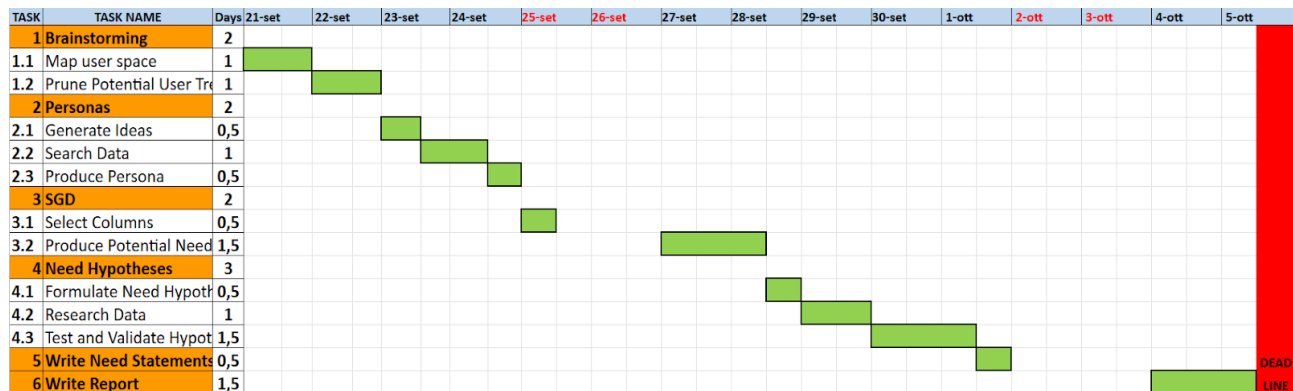
Task 1

TASK	TASK NAME	Days	21-set	22-set	23-set	24-set	25-set	26-set	27-set	28-set	29-set	30-set	1-ott	2-ott	3-ott	4-ott	5-ott
1	Brainstorming	2															
1.1	Map user space	1															
1.2	Prune Potential User Tre	1															
2	Personas	2															
2.1	Generate Ideas	0,5															
2.2	Search Data	1															
2.3	Produce Persona	0,5															
3	SGD	2															
3.1	Select Columns	0,5															
3.2	Produce Potential Need	1,5															
4	Need Hypotheses	3															
4.1	Formulate Need Hypoth	0,5															
4.2	Research Data	1															
4.3	Test and Validate Hypot	1,5															
5	Write Need Statements	0,5															DEAD
6	Write Report	1,5															LINE

Figure 10: GANTT chart for the tasks performed during the first part of the project. Each cell corresponds to half a day. Each task is assigned a duration in days, and the green bars show it graphically.

Task 2

TASK	TASK NAME	Days	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
1	Initial Need Revision	3																						
1.1	Data Research	3																						
1.2	Quantify Users	0,5																						
1.3	Revise Statements and Users	2																						
2	Importance	1																						
2.1	Assign ranks to Maslow's Framework	0,5																						
2.2	Assign statements to Maslow's Levels	1,5																						
3	Confidence	2																						
3.1	Give a Confidence vote to statements	1,5																						
3.2	Make the mean of the votes	0,5																						
4	Normalization and Ranking	0,5																						
5	Final Decision	1,5																						DEAD
6	Write Report	3																						LINE

Figure 11: GANTT chart for the tasks performed during the second part of the project. Each cell corresponds to half a day in the month of October. Each task is assigned a duration in days, and the green bars show it graphically.

3.4 - RACI

The RACI tables shown below represent the **division of roles** among the group members, for each macro activity performed in the process. Most activities, especially in the first part of the project, were carried out together in a group, or in parallel and then reviewed by the other members for feedback, hence the high number of R and R/C roles in the tables (**Table 15 and Table 16**).

Task 1

Step	Activity	Salvo	Andrea	Ilenia	Jenni
1	Brainstorming	R/C	R/C	A	R/C
2	Personas	R/C	R/C	R/C	A

3	SDG	R/C	A/R	R/C	R/C
4.1	Formulate Need Hypotheses	A	R	C	R
4.2	Search Test Methods	R	R	R	A/R
4.3	Test Hypotheses	A/R	R/C	R	R
5	Need Statements	R	R	A	R
6	Report	C	C	A/R	R

Table 15: RACI table for the first part of the project.

Task 2

Step	Activity	Salvo	Andrea	Ilenia	Jenni
1	Need Revision	R	A	C	R
2	User Quantification	A	R	R	R/C
3	Importance	R	A/R	C	I
4	Confidence	A/R	R	R	R
5	Normalization and Ranking	R/C	A/R	I	I
6	Final Decision	A/R	R/C	R/C	R/C
7	Report	R/C	R/C	R/C	A/R

Table 16: RACI table for the second part of the project.

Chapter 4 - Solution Identification

4.1 - Introduction

The aim of this report is to identify a list of solutions that can solve the need identified in the previous project phases. The team tried to find solutions for the following need:

"**Students → *Need to receive an education that is effective in preparing them for the jobs they aspire to, and that teaches them useful skills which are requested from the labor market, in order to increase their employability right after graduating.***"

In the section "Methods", we will describe the methods we adopted in order to identify the solutions to the need and the reasons why we chose them.
In the conclusive section "Results", we will present the outputs achieved and then describe them through lists and tables.

4.2 - Methods
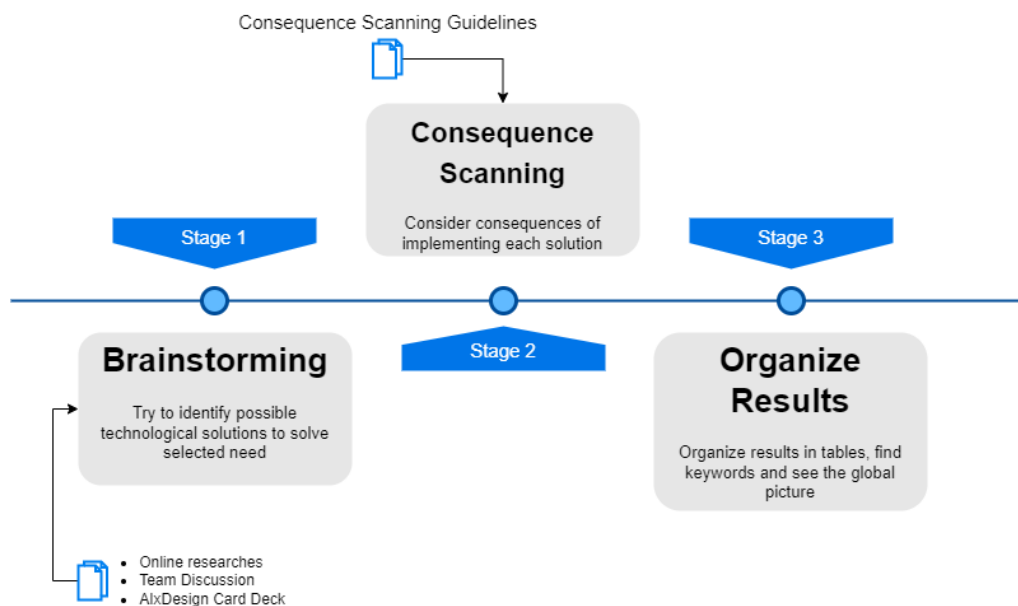
Figure 12: Stages of Solution Identification Process

The first method used for the solution identification is **brainstorming** with the ***AI meets Design ideation card deck****.* The aforementioned card deck is a set of cards used to help designers in developing ideas making use of various AI techniques. It is composed of 24 cards, divided into 6 categories. Each of them represents an "area of opportunity for users' experiences" (*AIxDesign Community | Aixdesign.Co*, n.d.), namely:

1. **Smart things + post-pixel interfaces**: *Internet of things and AI enable new ways of interfacing with our technology for example through speech, gestures, and connected objects and spaces.*

2. **Anticipatory + agentive:** *Anticipatory design predicts and delivers what users want before they request it. Agentive tech acts on these predictions (semi-) autonomously to perform a task on the users' behalf.*
3. **Backstage**: *Automating certain tasks and parts of the process can shift scale and costs to serve new audiences, eradicate delays and help your user instantly, and enable new types of experiences.*
4. **Affective**: *Emotion AI/affective computing includes machines being able to read, interpret, act on, and imitate human affect and empathy.*
5. **Deep personalization**: *The machine gets to know each individual user over time and continuously adapts the system to best serve their needs.*
6. **Context-aware**: *Context-awareness or contextual computing means understanding the current environment of your user and adapting behaviors accordingly.*

We had an ideation session with the set of cards and for each of them, we developed at least one idea.

After having a list of ideas, we decided to use the "***Consequence scanning***" method to analyze our outcome. We chose this method because it allows us to consider the consequences of the ideas, and it gives the opportunity to avoid potential harms (*Consequence Scanning – an Agile Practice for Responsible Innovators – Doteveryone*, n.d.). This method requires again a brainstorming activity, about the impact of the technological features of our ideas.

In this process (which is structured into several phases, as described in the method guidelines (*Consequence Scanning – an Agile Practice for Responsible Innovators – Doteveryone*, n.d.)) the team had to answer three questions, considering each of our ideas identified with the AIxDesign card deck:

1. *What are the **intended** and **unintended consequences** of this product or feature?*
2. *What are the **positive consequences** we want to focus on?*
3. *What are the **consequences** we want **to mitigate**?*

At the end of this process, we decided to summarize the outcome of the three questions and display it in two points: positive and negative consequences.

4.3 - Results

4.3.1 - Starting Point Idea
The following results were obtained from the brainstorming with the AI meets Design ideation card deck and the Consequence scanning analysis.

Using the AIxDesign card deck, we noticed that the following card in particular gave us a good starting food for thought:

- What if you can **extract information from large sets of text**? Scrape data from different sources, generate summaries, extract specific bits of information. Possible but less common on multimedia like images and videos.

In fact, we tried to give an evident reason to implement a **data science-based system** starting from the identified need, analyzing the state of the education world and of the job market.

The result of this first preliminary phase has become concrete in the following introductory idea, schematized in **Figure 13**.

Idea: Since the need we selected is about helping people in learning **useful skills** to increase their **employability**, it is impossible to devise any solution without getting to know in detail which are the skills that are more important and requested for a given job market area.

Nowadays websites like "LinkedIn", "Glassdoor", "Indeed" etc host a massive amount of job postings from which we could retrieve, using various data scraping techniques, precious information to create a representation of the job market in data form. Thanks to the information we get, many useful applications could be created: most of the solutions which are proposed in this report are generated from this **starting point**.
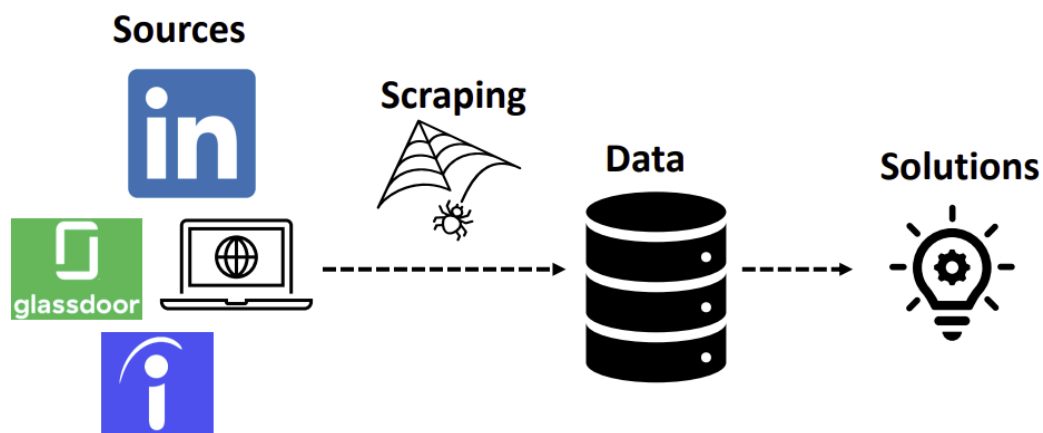
Figure 13: Diagram showing the web scraping task on which we will build our solution

4.3.2 - Possible Solutions

The following section shows the possible solutions identified with the AIxDesign ideation card deck, together with their positive and negative consequences arising from the Consequence Scanning session. The solutions are grouped by the category of cards that helped generate them.

Smart things + post-pixel interfaces

Mix of two cards*:*
- What if your user can interact through conversational language?
- What if your user interacts through speech?

Idea: implementing a chatbot with which the user can interact to perform custom searches, get information based on queries obtained from textual questions, etc... enhance the chatbot with the recognition of voice messages.

Consequence scanning:
1. **POSITIVE**: offer the user an attractive interaction system different from a classic search bar, stimulating the user to use the app through this integrated feature.
2. **NEGATIVE**: avoid an incorrect use of the feature, due to a bad presentation of it or to a difficulty of use of the user. It must be easy to use, through spoken or written language correctly analyzed by the algorithms at the base.

Mix of two cards*:*

- What if you can recognize and respond to users' body and hand gestures?
- What if it exists inside an object in the physical world?

Idea: A system of analysis of user behaviors, words, and gestures could be implemented within a robotic system or a virtual interface. The system could interview the user with generic or more specific questions about their skills, analyzing the user's real-time reactions. The system could provide feedback to the user by giving him an assessment of his current situation, proposing how to improve his skill set.

Consequence scanning:
1. **POSITIVE**: Stimulate companies to invest in the potential of the system. On the user side, provide an interactive experience well integrated with the job market in order to develop a sense of self-esteem and admiration for the company.
2. **NEGATIVE**: We want to avoid artificial intelligence not being able to properly analyze user behavior, providing incorrect feedback. The system, moreover, must only be a trial method of access to the final platform.

Smart things + post-pixel interfaces			
Cards	**Solution idea**	**Positive consequences**	**Negative consequences**
Conversational language & speech	Implement a chatbot to interact with to make dynamic research and get feedback	Provide a different and way of communication with the system	May be difficult to integrate and build in a well-done form
Body and hand gestures & physical object	Implement an interactive system in a robot or in a virtual interface to communicate with in order to get feedback and suggestions.	Stimulate companies to use the system in a sponsor perspective. Give users an exciting experience	Making this tool robust and reliable during the interaction may be difficult. It doesn't replace the final system

Table 17: Summary of "Smart things and post-pixel interfaces" cards ideas and consequences

Anticipatory + agentive

Card:
- What if your user no longer has to interact with the tool to 'get the job done?

Idea: Use historical data to map users into clusters of similar individuals with respective areas of expertise and proposes complementary skills to improve their profile. Show to users how related or unrelated his skills are by scores.

Consequence scanning:
1. **POSITIVE**: Create a sense of challenge and self-evaluation in the user, so that he/she is encouraged to use the system to improve his/her skills.
2. **NEGATIVE**: Create a sense of mistrust in the user, in case of an unsuitable profile, or limit them to specific skills without giving the opportunity to broaden their working vision. Avoid wrong advice (outliers, errors in the algorithms, etc.)

Card:
- What if you can predict what your user will need or want to do next?

Idea: Using big data on the demands of companies, forecast the demand for a specific sector with related skills, providing the user job prospects in the coming years based on their profile, suggesting which technologies to focus on to have more future possibilities.

Consequence scanning:

1. **POSITIVE**: Ability to provide reliable, useful forecasts that users can use to improve themselves. Create in them a sense of continuous innovation.
2. **NEGATIVE**: Avoid wrong predictions. The feature should not be seen as an "oracle" but presented as an overview of the current and probable future situation.

Card:

- What if it is pro-active?

Idea: Create a sort of "Work Tinder", proposing to users companies that require skills similar to theirs and vice versa. Analyze company data (exploiting required professional profiles, skills, and personnel by identifying patterns) to make the app up to date to notify its users on the technologies on which to focus on.

Consequence scanning:

1. Encourage the entry of business users into the system and stimulate users to use it as a source of knowledge, work, and opportunities.
2. Avoid fake company profiles, which can not only compromise the trust of individual users but also reduce the quality of the data and suggestions shown.

Anticipatory + agentive			
Card	**Solution idea**	**Positive consequences**	**Negative consequences**
Get the job done	Cluster similar users with respect to skills and profile	Self-evaluation and challenge between users	Avoid mistrust in users. Do not limit their perspective
Predict what users need	Forecast demand of a specific sector with related skills	Create a sense of continuous innovation	Avoid wrong predictions. It is not an oracle.
Pro-Active	Create a Work Tinder to match uses and job opportunities. Send notifications on the technologies to improve	Stimulate companies to participate in the system. Tool to find jobs and skills suggestions	Avoid fake accounts, protect data quality and improve results reliability

Table 18: Summary of "Anticipatory + agentive" cards ideas and consequences

Backstage

Card:

- What if you could automatically pick up on unusual or undesired behavior?

Idea: In the context of an application that scrapes job postings for info regarding the job market, implement an anomaly detector to recognize job postings with misleading titles (comparing job titles with requested skills and expected tasks) and exclude them from the analysis.

Consequence scanning:

1. **POSITIVE**: Include only relevant job offers in the statistics we want to compute, for example, those that use a catchy job title but are in fact offers for less specialized jobs than the user might think (e.g., the title "Data Scientist" is often used for different levels of positions)
2. **NEGATIVE**: Risk of the anomaly detection algorithm leaving out some niche, specialized offerings that could bring some insight to our model, for example for suggesting some useful skills to learn that are asked only on a minority of job offerings.

Card:
- What if you can convert across any data type?

Idea: Implement a text-to-speech transformer to allow the user to listen to articles while driving or commuting.

    Consequence scanning:
1. **POSITIVE**: Helping the user make the most out of their time, increasing their productivity
2. **NEGATIVE**: Most written knowledge sources are not easily digestible when translated into speech, e.g., scientific articles with a lot of charts and formulas. Users could become frustrated.

Card:
- What if you can generate new instances based on lots of examples?

Idea: Implement a generator of "LinkedIn-style" tests about various topics, to allow users to check on the skills they worked on. Ideally, the proposed questions should not be pre-defined but tailored to the sources the user studied the arguments on (maybe the sources were suggested to them by our application itself), with some baselines to compare the user's knowledge with, notifying them in case they've missed some key points about the subject matter.

    Consequence scanning:
1. **POSITIVE**: Increasing the user's productivity through the implementation of rewarding tests, making learning more interactive, creating a feeling of accomplishment, and conveying productive feedback when needed.
2. **NEGATIVE**: Tests too hard and/or not adjusted to the user's current level of knowledge might easily become frustrating.

Backstage			
Card	**Solution idea**	**Positive consequences**	**Negative consequences**
Pick up unusual behaviour	Recognize job postings with misleading titles and exclude them from any analysis	Include only relevant job offers in our statistics	Risk of leaving out some niche, specialized offerings that could bring some insight
Convert across data type	Text-to-speech transformer to listen to articles while driving or commuting	Help the user make the most out of their time	Some written articles are not enjoyable when translated into speech
Generate new instances	Generate tests and quizzes about the skills the user has been working on	Feeling of accomplishment, convey feedback	May cause frustration if not adjusted correctly to user's skills

Table 19: Summary of "Backstage" cards ideas and consequences

Affective

Card:

- What if you can sense and respond to your users' emotions (in real-time)?

Idea 1: Teachers can use a system to measure and identify students' learning behavior. For example, it would be possible to identify stress signals from students' voices with voice recognition. The collected data can provide feedback to teachers so they can see what should be repeated in lectures and what can be changed in the teaching methodology (Stahl, 2021, March 10).

    Consequence scanning:

1. **POSITIVE**: Improve teaching methodologies and understand what are the topics that are harder to understand for students, in order to prepare them for the jobs they aspire to do.
2. **NEGATIVE**: Having a less human connection between students and teachers. The system should not be completely automated and that would not make the students feel like they are alone.

Idea 2: A system that simulates job interviews based on your cv and what job you apply to. It uses facial recognition to understand emotions, and voice recognition to detect stress levels in the voice. After the interview gives feedback on what parts of the interview to improve.

    Consequence scanning:

1. **POSITIVE**: Teach students how to get ready for a real job interview, improve communication skills, overcome shyness, increase students' awareness of their skills and knowledge. Helps them to know more about the job they want to apply to and what to expect from the work environment.
2. **NEGATIVE**: The system could not be flexible enough for students, it may seem fake, and students would not consider the simulation real and not take it seriously. Improve the system with examples of other interviews made by HR professionals.

Card:

- What if you can simulate human qualities such as empathy, humor, and playfulness?

Idea: A chatbot that can help students fix their CVs based on the job they want to apply for. First, it makes personality questions, therefore it adapts to the personality of the user. Then it asks questions and replies to the user with regards to jobs/CV. It can also use voice recognition (*Interview Bot | Awesome Chatbot | Chatbot for Interview | HR & Recruitment Chatbot Examples | Conversational Landing Pages by Tars*, n.d.).

    Consequence scanning:

1. **POSITIVE**: Help students improve their CV, in order to increase their employability with an AI chat. It can help more introverted or busy students to check their cv.
2. **NEGATIVE**: The chatbot needs to be trained properly in order to avoid bias.

Card:

- What if you know the pain points and moments of delight for your user?

Idea: A website (that can be connected to users' social media) for users that are looking for a job and want to improve their skills (and CV). The website contains a "customer journey" online with questions related to skills they want, jobs they aspire to get, get reviews, surveys (to gather data). We can use user behavior analytics (*User Behavior*, 2021, September 9) to understand what

the users need (monitor user experience at each step- check actions, questions, motivations, barriers that make it difficult to move to the next stage)(*Customer Journey Maps*, n.d.).

Thanks to "heat maps" we can check where in-page users spend the most time and where they click with their mouse. This system allows us to check where users "get stuck" in the customer journey. We can analyze the behavior and choices of users with the collected data. Use sentiment analysis to determine if data is positive, negative (*How to Make Smart Decisions Based on Customer Journey Data Analysis*, 2020).

Consequence scanning:

1. **POSITIVE**: The website can help students in each step of the application of a job. We can check what are the hardest steps of the process and make those easier. Create even a sort of community where also students can help each other. This can help students to be more employable and be self-aware of their capabilities.

2. **NEGATIVE**: The process can be too long, this could discourage students. This can be fixed by creating a good-looking website, easy to understand and guides you easily.

Affective			
Card	**Solution idea**	**Positive consequences**	**Negative consequences**
Sense and respond to users' emotions	1)System that measures and identifies students' learning behavior, with voice recognition. 2)System that simulates job interviews, using facial and voice recognition.	1)Improve teaching methodologies 2) improve communication skills, increase students' awareness of their skills, knowledge and about the job.	1)Less human connection between students and teachers 2) students may not consider the simulation real and not take it seriously
Simulate human qualities	A chatbot that can help students fix their CV based on the job they want to apply for.	It can help more introverted or busy students to check their cv.	It can be biased
Know pain and delight points	Website that helps students to find a job. It contains features that allow us to see what are the hardest and easier stages of the process of job application for students.	It can help students to be more employable and be self-aware of their capabilities	The process can be too long, that could discourage students.

Table 20: Summary of "Affective" cards ideas and consequences

Deep personalization

Card:
- What if you can adapt elements of the interface to every user (in real-time)?

Idea: Specialized search engine which analyses popularity and reviews scores of knowledge sources (courses, videos, articles…) from various websites and proposes them to the user, accordingly ordered.

Consequence scanning:

1. **POSITIVE**: Help the user find and identify quality sources for their education, without wasting time on less effective resources.
2. **NEGATIVE**: Some resources that are niche, but still very good, might be lost in the filter, e.g., content about a very specific skill/tool that only the most specialized experts use.

Card:
- What if you can tailor the content for each user?

Idea: Suggest knowledge sources (courses, videos, articles…) based not only on the content you've consumed in the past, but most importantly on what other users with similar skillset/aspiration are learning through the platform (like what Spotify does with its recommender system).

   Consequence scanning:
1. **POSITIVE**: Make the user up to date with their "competitors" in the job market, showing them what people aspiring to the same position are focusing on.
2. **NEGATIVE**: Diversification might be a good thing! Having a different skillset from the rest of your peers might be what tips the scale in your favor when looking for a job. Therefore, don't forget that this feature might be aimed more at beginners in their fields, and useless if not detrimental to experts looking to hone their skills.

Card:
- What if you can organize plans and make matches without human assistance?

Idea: Implement an in-app calendar that optimizes your plans for work/lessons and tries to find you some time for self-improvement each day. Can be integrated with other ideas to make the app find interesting content for the user to read/watch based on their objectives, the allotted time and the previous content consumed.
   Consequence scanning:
1. **POSITIVE**: Increase in productivity for the user, improvement in time management, creation of good habits regarding self-improvement, and constant learning.
2. **NEGATIVE**: Risk of making learning a chore, annoying the user with notifications at inappropriate times.

Card:
- What if you know the core values and personality traits of your user?

Idea: Try to come up with a psychographic profile for the user (based on data, questions, habits…) and give them insight on how they could improve in the soft skills department. Could also suggest some jobs in their fields that are a good fit for their persona, and/or help them gain the skills they lack for the position they aspire to (e.g., leadership for a manager, teamwork for scientists that must work in groups, etc.)
   Consequence scanning:
1. **POSITIVE**: Make the user more aware of where they stand in the psychological spectrum, what soft skills are they good at, what they should instead try to improve.
2. **NEGATIVE**: Inferring a psychological profile risk to be a process that is tedious for the user and/or inaccurate, making the user feel like they are wasting their time with this feature.

Deep Personalization			
Card	**Solution idea**	**Positive consequences**	**Negative consequences**

Adapt interface to each user	Search engine for knowledge sources, ranked by popularity and reviews	Identify quality sources for education	Leave out a niche, but valuable resources
Tailor the content for each user	Suggest knowledge sources based on what users with similar profiles are consuming	Make the user up to date with their "competitors"	Stifle diversification
Organize plans without human help	Calendar to schedule some time for self–improvement, suggesting the user interesting content	Increase productivity, improve time management skills, create good habits	Risk of making learning a chore
Knowing the personality of the user	Try to infer a psychological profile for the user and help them improve their soft skills	Make the user more aware of their skills and potential	Maybe a tedious process for the user

Table 21: Summary of "Deep Personalization" cards ideas and consequences

Context-aware

<u>Card</u>:

- What if you understand your users' social context -who they're with and what their relationship to that person is?

Idea: Implement a tool that considers the geographical position of other users, using Geolocalization. The goal is to propose advanced courses, job opportunities, and notifications to the user, and for their neighbors in order to create groups. It can be compared to the exchanging of coupons in online shopping so that the whole community benefits from them.

  Consequence scanning:

1. **POSITIVE**: This method is based on weak ties (Sociologicamente, 2018) and increases the interactivity and sociality
2. **NEGATIVE**: It could be a little confusing, people cannot understand what is for him/her and what is for the other. Need to organize this function in an ordained and separated way.

<u>Card</u>:

- What if you can see through your user's eyes and respond (in real-time) to what they're seeing?

Idea: Integrate a function that allows the user to take pictures of formulas or texts, to be directed towards a discussion thread about it online, a study group in your university, or external courses about the topic.

  Consequence scanning:

1. **POSITIVE**: The information is more accessible and freer, and it is simple to take part in a study group with colleagues
2. **NEGATIVE**: People cannot define this information as useful or appropriate. Need to implement a filter and/or a ranking system that certifies competency and correctness.

<u>Card</u>:

- What if you understand where your user is & what they're doing?

Idea: Using the geolocation system, the product sends a notification to the user to inform that closer to him/her there are opportunities to work, but also if there are societies, groups that provide further and advanced courses or simply to receive help to study, based on the user request. This

potential is limited where you are driving, or it's night hour; in this case, notifications are silent in order to not distract the user. Prudence and safety first!

Consequence scanning:
1. **POSITIVE**: Avoid that these notifications pop up in dangerous or inappropriate situations
2. **NEGATIVE**: Need to implement a system that understands these situations. Different users have different perceptions of what is a good time.

Context-Aware			
Card	**Solution idea**	**Positive consequences**	**Negative consequences**
Understand the users' context and their relationship	To create a set of notification useful also for the closer user	Take advantage of weak ties and increase the interactivity and sociality	It could be a little confusing
Respond to what the user sees	A function that permits the access to other documentation or study group related the arguments pictured by camera	It's easy and immediate receive information about the topic	The information could be not appropriated or useful
Understand where the users are and what they are doing	Implement a set of notifications that inform the users about nearest possibilities, only in the suitable moment	To avoid ignored notifications or make them causes of an accident or unsafe situations	Different users have different perceptions of which is a good time.

Table 22: Summary of "Context-Aware" cards ideas and consequences

4.4 - *Summary Table of Solution Ideas*

To have a general view of all the possible solution found, we propose the following table that summarises and groups together those found in the previous subsection:

Extracting information from large sets of text…	…retrieve job postings information through web-scraping, to get a data representation of the job market for various fields. With it, we could build the following solutions:			
Card	**Solution idea**	**Positive consequences**	**Negative consequences**	**KEYWORD**
Smart things + post-pixel interfaces				
Conversational language & speech	**Chatbot** to make dynamic research	Different way of communication	Difficult to build	**CHATBOT**
Body and hand gestures & physical object	**Robot or Virtual Interface** to get feedback	Exciting experience	Difficult to make robust and reliable.	**BODY AND HAND GESTURES**
Anticipatory + agentive				
Get the job done	**Cluster** similar users	Self-evaluation and challenge	May limit users' perspective	**CLUSTERING**

Predict what users need	**Forecast** demand and skills	Continuous innovation	Account for wrong predictions	**FORECAST**
Pro-Active	**Matching** users to companies requesting their skills	Find jobs and skills suggestions	Data quality and results reliability	**MATCHING SYSTEM (TINDER WORK)**
Backstage				
Pick up unusual behavior	Recognize postings with **misleading titles**	Consider only relevant job offers	Leave out niche, specialized offerings	**OUTLIER DETECTION**
Convert across data type	**Text-to-speech transformer** to listen to articles	Make the most out of user's time	Some content may not be enjoyable	**TEXT TO SPEECH**
Generate new instances	**Generate tests and quizzes** about skills	Feeling of accomplishment	May cause frustration if not calibrated	**QUIZ GENERATION**
Affective				
Sense and respond to users' emotions	1) **learning behavior, with voice recognition.** 2) **simulate job interviews**, using facial/voice recognition.	1)Improve teaching methodologies 2) improve communication skills	1)Less human connection 2) May not be taken seriously	**AI INTERVIEWER**
Simulate human qualities	**Chatbot** to fix CV	Help introverted or busy users	It can be biased	**CHATBOT**
Know pain and delight points	**Website** that helps users **to find a job**.	Help users become more employable and self-aware	process too long, could discourage students.	**ML CUSTOMER JOURNEY**
Deep Personalization				
Adapt interface to each user	**Ranking search engine** for knowledge sources	Suggest only quality sources	Leave out niche, but valuable resources	**RECOMMENDER SYSTEM**
Tailor the content for each user	**Suggest sources** based on what similar users are consuming	Make users up to date with their "competitors"	Stifle diversification	**RECOMMENDER SYSTEM**
Organize plans without human help	**Calendar** to schedule time for self–improvement	Increase productivity	Risk of making learning a chore	**AI AGENDA**
Knowing the personality of the user	**infer a psychological profile**	Make users more aware of their soft skills	May be a tedious process	**PERSONALITY IDENTIFICATION**
Context-Aware				
Understand the users' context and their relationship	**Contex-based notifications** to close users	Increase interactivity and sociality	May be confusing	**SMART NOTIFICATIONS**
Respond to what the user sees	**Find documentation or study groups** using camera	Easy and immediate way of searching info	Hard to implement in an effective way	**SMART LENS**
Understand where the users	**Notifications** about near possibilities, but	Avoid causing unsafe situations	May have different perceptions of	**SMART NOTIFICATIONS**

are and what they are doing	only in suitable moment	(e.g. when driving or sleeping)	what is a suitable time.	

Table 23: Summary Table of all cards ideas and consequences

Chapter 5 - Solution Assessment Report

5.1 - Introduction

The final chapter's aim is to explain how the team carried out the solutions assessment process for the potential solution ideas produced in the previous phase of the project.

In the following sections, we will describe the method used and display the results.

5.2 - Methods
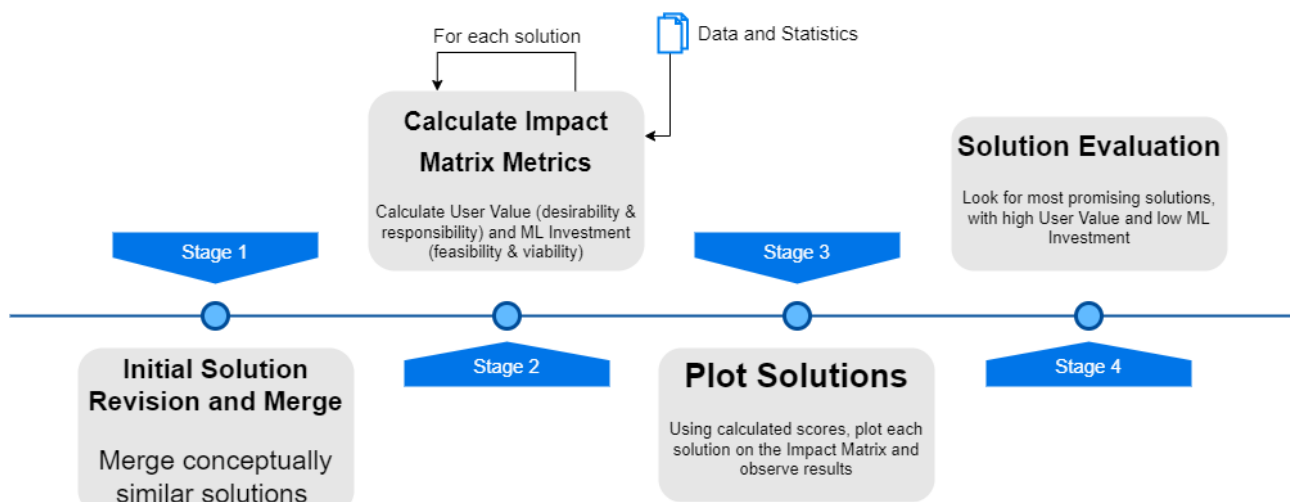
Figure 14: Followed Step for Solution Assessment phase

5.2.1 - Initial Solution Revision and Merge

Starting from the output of the previous phase the potential solutions have been analyzed altogether in order to merge conceptually similar ones coming from different card prompts.

5.2.2 - Impact Matrix

To assess possible solutions, we used the **Impact Matrix** method, as described in the **AIxDesign Toolkit.** *(AIxDesign. n.d. AIxDesign Community | aixdesign.co.)*

It consists in placing each idea in a cartesian plane (**Figure 15**), according to the amount of **Value** it could bring to the **User** and to the **ML Investment** required for implementing it.
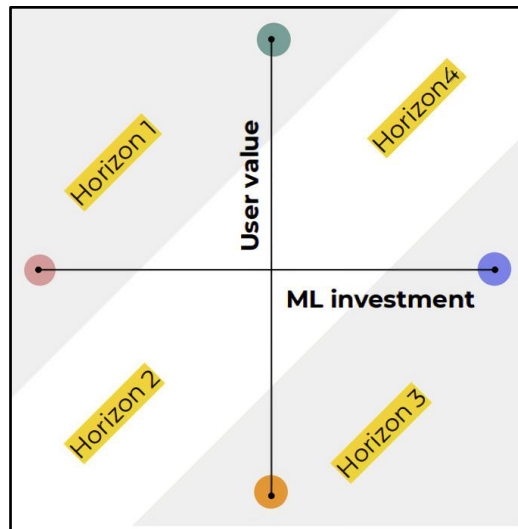
Figure 15: Impact Matrix

Ideas are categorized based on the quadrant they fall into:

- **Horizon 1:** Low ML Investment / High User value: good ideas to carry out
- **Horizon 2:** Low ML Investment / Low User value: ideas to consider
- **Horizon 3:** High ML Investment / Low User value: ideas to discard
- **Horizon 4:** High ML Investment / High User value: ideas beyond our possibilities

5.2.2.1 - How to Assign Scores

Both **User Value** and **ML Investment** are composed of two metrics, as shown in **Table24**:

Axis	Metric	Description
User Value	**Desirability**	How much value does the solution bring to the user
	Responsibility	Unintended consequences, edge cases, misuse and ethical impact of a solution
ML Investment	**Feasibility**	Ease of collecting, cleaning and managing data
	Viability	Estimate costs, ROI and implementation difficulties

Table 24: Description of the metrics involved in the Impact Matrix

The **User Value** is an intrinsically more qualitative metric, and we tried to integrate our reasoning with some online research.

For measuring **Machine Learning Investment** it is instead easier to be quantitative since it is about more technical aspects.

The team performed online researches about different aspects of each solution to assign a numeric score to each metric, trying to answer questions such as those shown in **Table 25**:

Metric	Questions	Sources (examples)
Desirability	- How many users does the solution impact? - Is the solution unique in some way? - What does the user gain in comparison to what they are already using?	- Statistical reports, - State of the Art, - Feedback and Trends about existing solutions
Responsibility	- What are the negative consequences identified in the consequence scanning phase? - Can the solution be misused by users? - Ethical and Social consequences: privacy issues, economic inequalities, diversity and inclusiveness, transparency	- Consequence Scanning output, - Social analysis, - Online Research
Feasibility	- Do we own or are we able to gather data we need? - Is it easy to collect a big quantity of data? - Is data easy to organize and elaborate? - Does there exist any API to easily collect data?	- Scientific papers, - Technological implementations, - Study of already existing systems
Viability	- Are there existing models or algorithms to build on? - What is the time to model? - How does it return value of investment?	- Scientific Papers, - Existing Algorithms analysis, - Pre-Existing Knowledge, - Market Price Lists

Table 25: Questions to answer and sources to explore in order to assign scores to the metrics involved in the Impact Matrix

Each team member has performed research individually to maximize the number of sources at our disposal. After this information collection phase, single scores have been assigned to each metric, based on the following ranking:

User Value and ML Investment Evaluation Scale
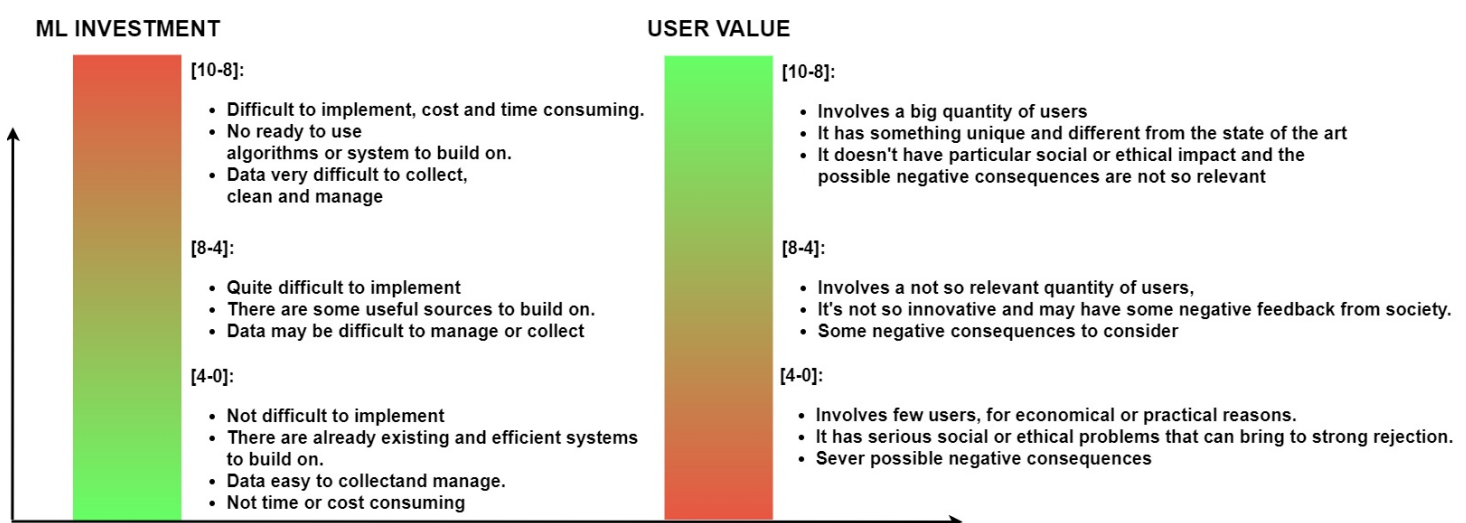
Figure 16: Impact Matrix Metrics evaluation Scale, used in order to assign scores

The final score of each metric has been assigned as the average of each team member's score. Using them as coordinates, we plotted solutions in the **Impact Matrix.**

Solutions falling into the **Horizon1** (High User Value/Low ML Investment, refer to **Figure 15**) are the ones that should be carried on to the next phases of the process.

5.3- Results

5.3.1 - Initial Solution Revision and Merge

The following solution ideas, arised from different card outputs, have been grouped together due to their similarity, as shown in **Table 26**. The respective positive and negative consequences identified during Consequence Scanning have been carried on to the combined solutions.

From card	Solution Idea	Combined Solution
Conversational Language & Speech	Implement a chatbot to interact with to make dynamic research and get feedback	Implement a chatbot to interact with to make dynamic research, get feedback and fix the CV based on its own profile
Simulate human qualities	A chatbot that can help students fix their CV based on the job they want to apply for.	
Get the job done	Cluster similar users with respect to skills and profile	Cluster users to suggest similar profiles and skills. Notification system tailored for similar users
Tailor the content for each user	Suggest knowledge sources based on what users with similar profiles are consuming	
Understand the users' context and their relationship	Create a set of notifications for closer users	

Table 26: Solutions merged in the initial revision phase

5.3.2 - Impact Matrix

5.3.2.1 - Assigning Scores

In this section, there are shown examples of research conducted to determine the User Value brought by a solution in this assessment phase; and the ML Investment needed to implement it, in a way that injects as much as objectivity as possible in the evaluation process.

For example, **Figure 17** shows an already existing algorithm to perform **matching mechanisms**.
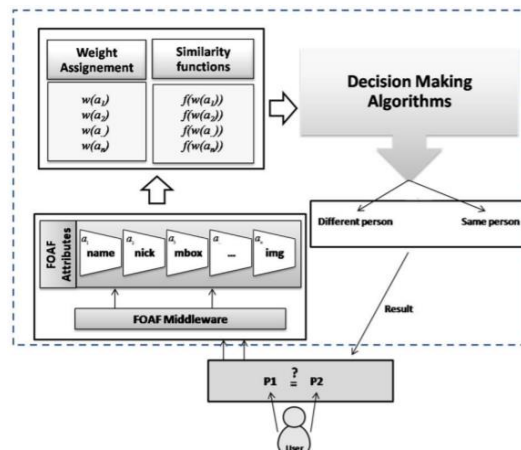
Figure 17: Example of the already existing approach to perform Matching mechanisms, useful to understand the complexity of the technology and possible implementation difficulties (Elie Raad, Richard Chbeir, Albert Dipanda. User profile matching in social networks)

Figure 18 represents a summary of Machine Learning and AI growth statistics, referring to most requested occupations, skills and posting counts.
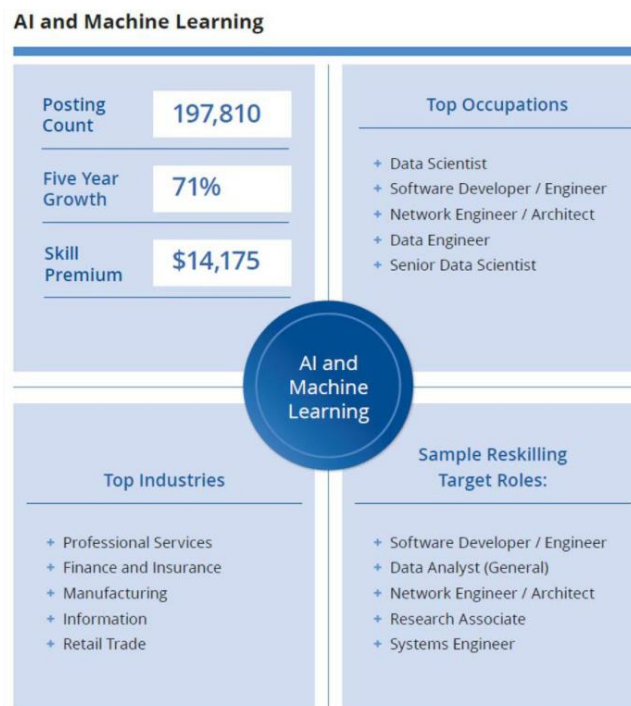
Figure 18: Example of statistical data about AI and ML evolution, most frequent skills, and posting counts. Useful to estimate user value in terms of users involved (Columbus, L. (2022). Top 10 Tech Job Skills Predicted To Grow The Fastest In 2021)

Figure 19 shows real prices provided by **Amazon** to use a Cloud Chatbot Service.

Caratteristica	Fino a 10 milioni di unità	Da 10-50 milioni di unità	Oltre 50 milioni di unità
Estrazione di frasi chiave	0,0001 USD	0,00005 USD	0,000025 USD
Analisi delle emozioni	0,0001 USD	0,00005 USD	0,000025 USD
Riconoscimento delle entità	0,0001 USD	0,00005 USD	0,000025 USD
Rilevamento della lingua	0,0001 USD	0,00005 USD	0,000025 USD
Rilevamento eventi per tipo di evento	0,003 USD	0,0015 USD	0,00075 USD
Analisi della sintassi	0,00005 USD	0,000025 USD	0,0000125 USD

Contattaci per conoscere i prezzi di volumi superiori a 100 milioni di unità al mese.
Le richieste di elaborazione del linguaggio naturale vengono misurate in unità di 100 caratteri, con una tariffa minima di 3 unità (300 caratteri) a richiesta.

Prezzo per unità

Caratteristica	Fino a 10 milioni di unità	Da 10 milioni a 50 milioni di unità	Da 50 milioni a 100 milioni di unità	Oltre 100 milioni di unità
Rilevamento PII	0,0001 USD	0,00005 USD	0,000025 USD	0,000005 USD
Contiene PII	0,000002 USD	0,000001 USD	0,0000005 USD	0,0000001 USD

5.3.2.2 - Score Table

Table 27 shows the average of the votes [0-10] assigned by each individual team member to the Desirability, Responsibility, Viability, and Feasibility of each possible solution, represented by a short name for ease of referencing. These scores have then been averaged metric by metric. The final coordinates for plotting the ideas in the Impact Matrix are the mean of such averages for the respective couple of metrics.

Solution	Averaged Scores				Final Coordinates	
	USER VAL (avg)		ML INV (avg)		USER VALUE (Y axis)	INVESTMENT (X axis)
	Desir.	Respon.	Viab.	Feas.		
Recommender	8,5	9	4	2	**8,7**	**3,1**
Generate Quizzes	9	7	5	4	**8**	**3**
'Tinder' Work	7,5	8	3	2,1	**7,7**	**2,4**
Agenda	7	7,5	3	2	**7,2**	**2,5**
User Clustering	7	7	4	3	**7**	**3,4**
Anomaly Detection	7	6	2,5	3	**6,5**	**2,7**
Forecast	8	7,4	4,5	5	**7,6**	**4,7**
ML Customer Journey	8	5	6	5	**6,3**	**5,5**
Chatbot	5	7	5	6	**5,7**	**5,4**
Personality Identification	6	5	6	4,8	**5,5**	**5,3**
AI Interviewer	6	4,8	9	8,5	**5,3**	**8,8**
Smart Lens	5	3,8	8	4	**4,1**	**6**
Body and Hand Gestures	4	3,5	9	7	**3,7**	**8**
Text-to-Speech	4	3,5	3	2,8	**3,8**	**2,9**
Smart Notifications	5	4,5	2	2	**4,8**	**2**

Table 27: Score Assignment Table (single scores are not reported due to space reason)

5.3.2.3 - Solutions Plotted in the Matrix

Figure 20 shows how the solution ideas we generated fall into the Impact Matrix quadrants, which are color-coded with respect to the correctness of the solutions they contain, according to this method.
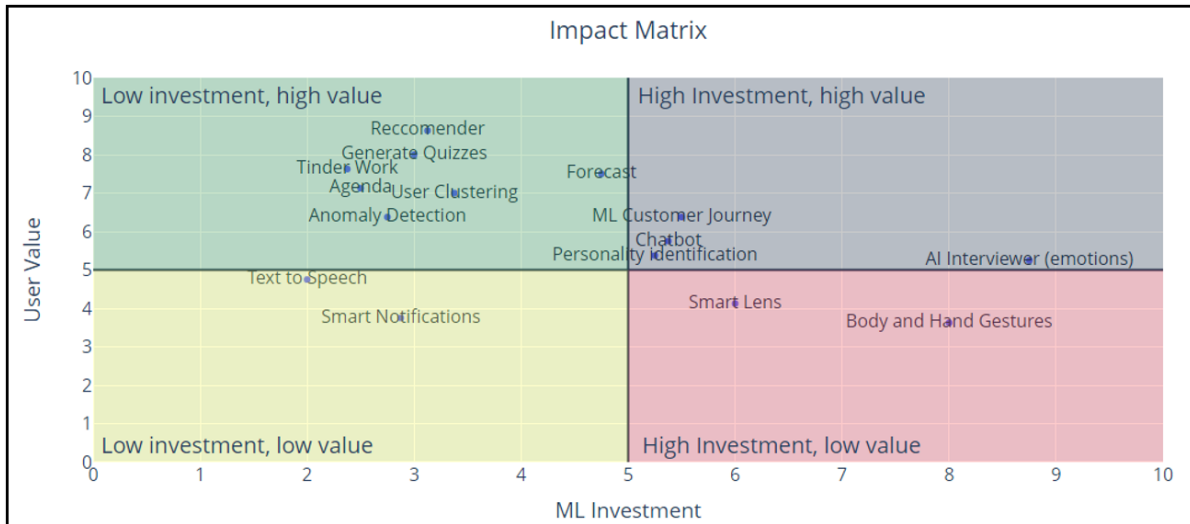
Figure 20: Final Impact Matrix for the Solutions

Ideas in **Horizon 1 (green quadrant)** are those that we are going to consider for our pretotype tests, described in the next chapter.

Using the list of most promising solutions, we came up with the idea of a single web-scraping based data service, with the purpose of improving the user's value on the job market, including the following features:

- A **Recommender** that suggests useful skills to obtain/improve for the user's desired job, and the best sources to learn them.
- A system that **Generates Quizzes** to test the user's familiarity with the learned subjects.
- A **Forecast** algorithm for trying to predict which skills will be more popular in the future.
- A **smart Agenda** to help the users find some time for self-improvement and to make it to good use in an efficient way.
- A **'Tinder Work'** function to show users which companies value the skills they possess the most and foster curiosity about the job market.
- A **Clustering** system to group together users with similar interests.
- An **Anomaly Detection** algorithm that drops fakes job postings to guarantee clean and reliable data

Chapter 6 - PreTotype Report

6.1 - Introduction

In this final phase of the project, we **tested** potential solutions obtained from the previous stage with a sample of potential users. Firstly, we will try to test the general idea of the solution using a **Fake Door**.

After that, we will try to estimate the grade of appreciation of single ideas using a **Paper simulation** of the system. All this process will use the pre-prototyping technique.

6.2 - Methods

The following diagram (**Figure 21**) summarizes the entire process of this phase, discussed later in detail:
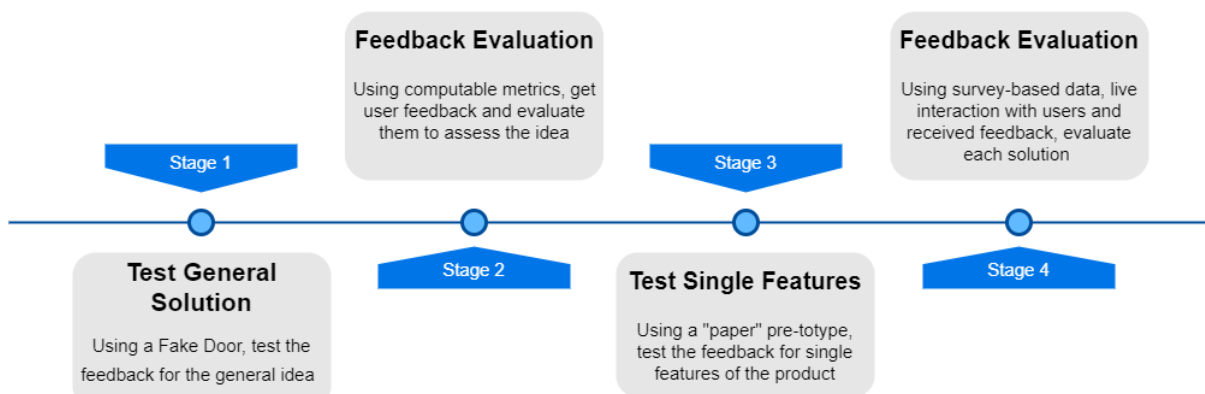
Figure 21: Followed Steps for the Pretotyping phase

We selected for testing the features listed at the end of Chapter 5, except for the Anomaly Detection since it is an "under the hood" feature, too technical to be shown in a Pretotype of the system and also, it does not affect the user testing experience on a surface level.

In addition to this list of possible features, we also considered a possible **Social Component** that allows users to get in touch with each other in single chats or groups, with the purpose of sharing information, solving tasks, asking questions, doing networking and in general, improving together.

6.2.1 - Fake Door

Before testing single possible features, we needed to test the **general idea** of the product. To do so, a **Fake Door** has been implemented using **WordPress**, an open-source content management system that allows the publishing of free websites.

Figure 22 shows a screenshot from the Fake Door:

Skills Up

Migliora le tue potenzialità!

Esplora il mondo del lavoro e le tue potenzialità

Un insieme di tool e funzionalità basate su algoritmi di Machine Learning ti permetterà di avere una panoramica delle skills richieste dal mondo del lavoro per il tuo settore e fornirti suggerimenti per migliorare le tue capacità!

Agende intelligenti, previsioni sul futuro, quiz per testarti e molto altro ancora. Tutto questo in un'unica applicazione!

Figure 22: Main Content of the Fake Door

In order to reach as many users as possible, a sponsorship has been performed using an **Instagram Story Advertisement (Figure 23),** available for 24 hours with a direct link to the Fake Door.
It was possible to select a **target** to show the story to, with demographic and social filters.
The chosen users are Italian: the choice of this geographical location is due to the research conducted previously, which showed tangible problems in the area of employment and job search. Due to this choice, the fake door has been written in Italian. The selected age range of the target was between 18 and 30 years old. Target information is summarised in **Table 28**.
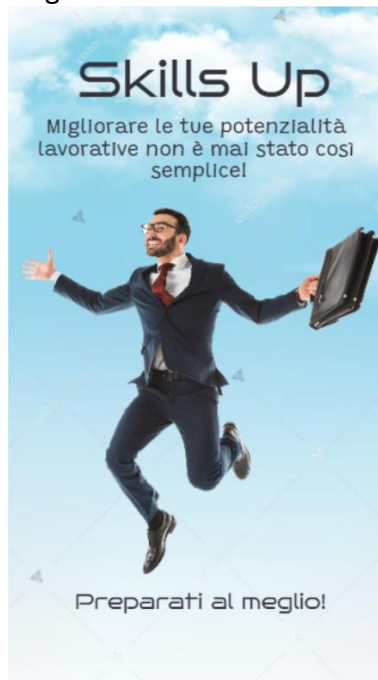
Figure 23: Instagram story used to sponsor the Fake Door

Country	Age Range	Sex	Adv Class	Estimated Reached Users

Italy	18-30	All	Employment	3100 - 11000

Table 28: User target for the sponsorship

To get quantitative feedback, the Fake Door contained a registration form, where the user had the possibility to insert a personal email address to receive updates on the state of the product. A like and dislike buttons have been added too, to keep track of less invested feedback (**Figure 24).**

Figure 24: Feedback form of the Fake Door

Summarizing the approach, the following **metrics** have been tracked during the sponsorship:

- Click-Through rate
- Conversion Rate
- Positive and Negative Feedback
- Number of Email addresses

6.2.2 - Paper Pretotype

After analyzing Fake Door results, we decided to test single features, using an easily producible Pretotype, more oriented on the real usage of the product.
In this way, it was possible to integrate, to the results of the fake door, more detailed data, related to user feedback and quantified during the test of this second Pretotype.

A **Paper Pretotype** was made using **Marvel App,** a free tool that allows connecting pictures with invisible linking buttons, creating a simulation of the system also with simple draws.

Figure 25: Example of the Paper pretotype

Tested users are university colleagues of team members, college students from different universities, and also some non-students of varying ages. During the usage of the pretotype, we tried to collect some information about our users' experience such as:

- live comments
- facial expressions
- questions
- order of features clicked
- time spent in exploring the pretotype
- final comments and suggestions

After trying out the pretotype, users were asked to compile a short and rank-based survey, in order to gather information about their experience in an more easily quantifiable way.

Figure 26: Examples of survey questions

6.3 - Results

6.3.1 - Fake Door feedback evaluation

The following table (**Table 29**) shows the statistics obtained from the use of the fake door, reporting the current values and the calculated metrics.

Metric	Values
IG Story views	3670
Fake Door views (IG Stories clicks)	108
IG Story Click Through Rate (CRT)	108/3670 (0.030%)
Fake Door Likes	63
Fake Door Dislikes	7
Feedback Conversion Rate	70/108 (0.65%)
Number of Mail Addresses collected	12
Mailing Conversion Rate	12/108 (0.11%)

Table 29: Fake Door Results Statistics

As **Table 29** shows, the results are quite satisfactory. The number of views to the fake door exceeds one hundred and, considering that this was sponsored through Instagram stories which are easily skipped by the users, confirms a general interest in the idea.

Moreover, considering the conversion rate, the number of users who have interacted with the fake door by entering their own feedback is very high, further confirming that users who are really interested in the product have devoted time to reading and understanding the idea.

However, the number of users who have provided us with an email address is much lower. This result was predictable, since requesting personal information from users involves privacy issues that drastically lower the number of consenting individuals.
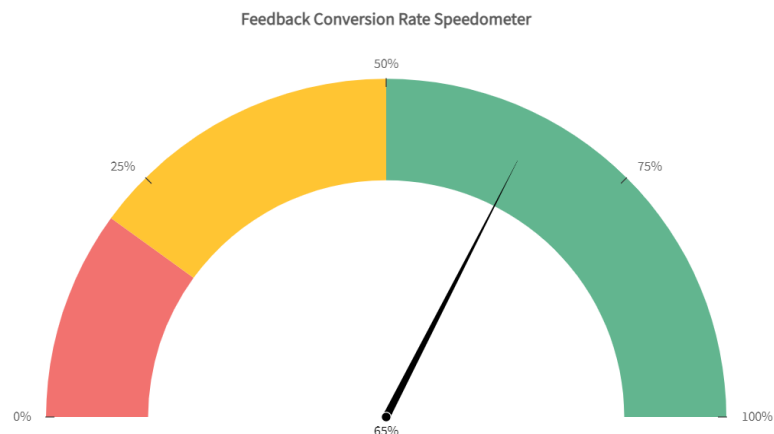
Figure 27: Feedback Conversion rate Speedometer
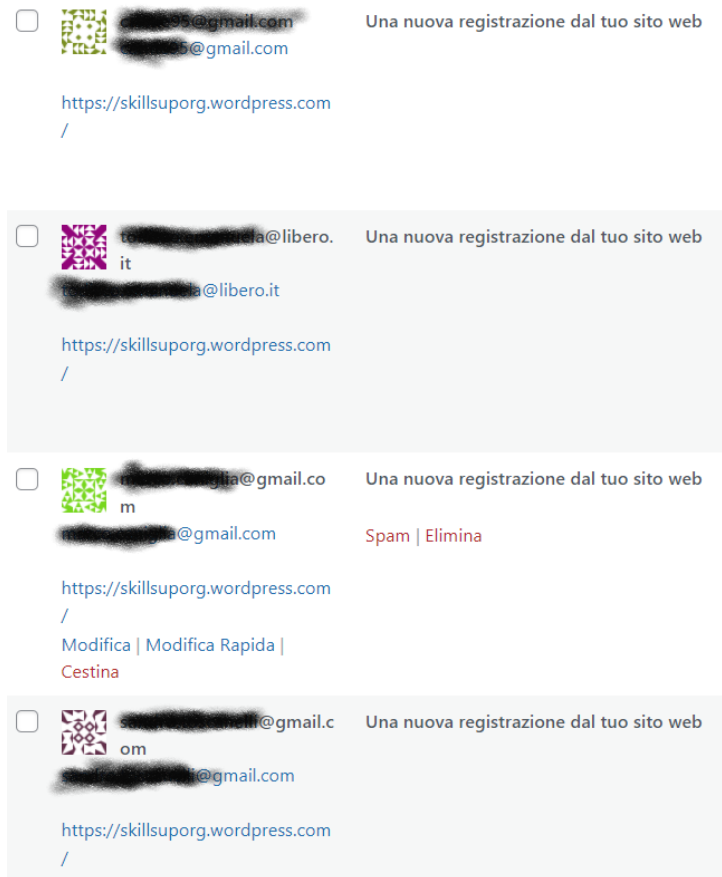
Figure 28: Examples of users that compiled the registration module. For privacy reason, mail addresses are obscured

In general, the results obtained from this experimentation are more than satisfactory. User interaction metrics indicate that there could be a concrete interest in the product idea, which will be further tested in the next section.

6.3.2 - Paper Pretotype feedback evaluation

In this section, some relevant examples of the results, extracted from the analysis of the google survey, are illustrated.

6.3.2.1 - Survey Results

This section shows examples of results from the questions included in the post-session survey we asked live testers to take.

In this first question **(Figure 29)** we asked to evaluate the general idea of the system. There has been positive feedback on average, with a high concentration of votes towards the higher values of the scale.
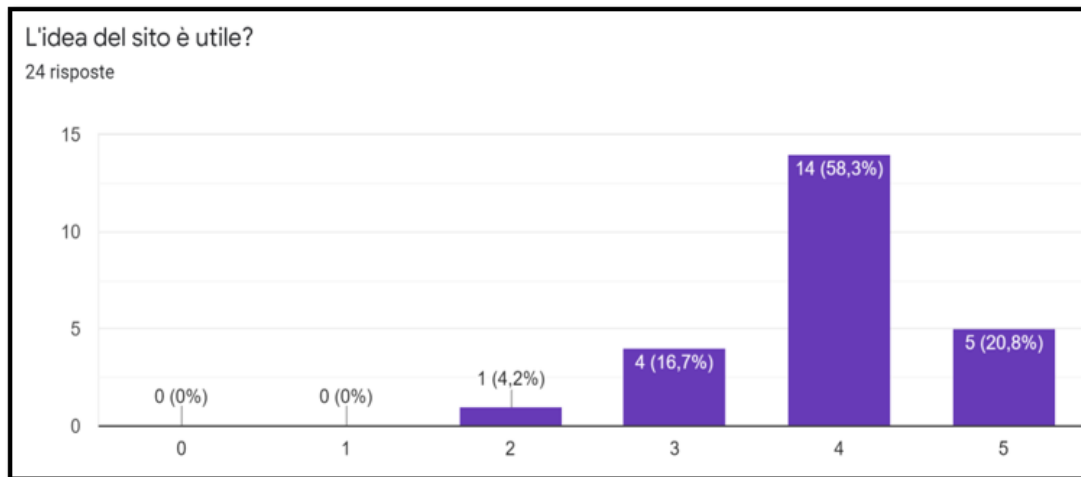
Figure 29: Overall Idea Scores

The following graph (**Figure 30**) shows the degree of appreciation of the quiz generator feature. positive feedback comprises almost eighty percent of the total number of testing users.
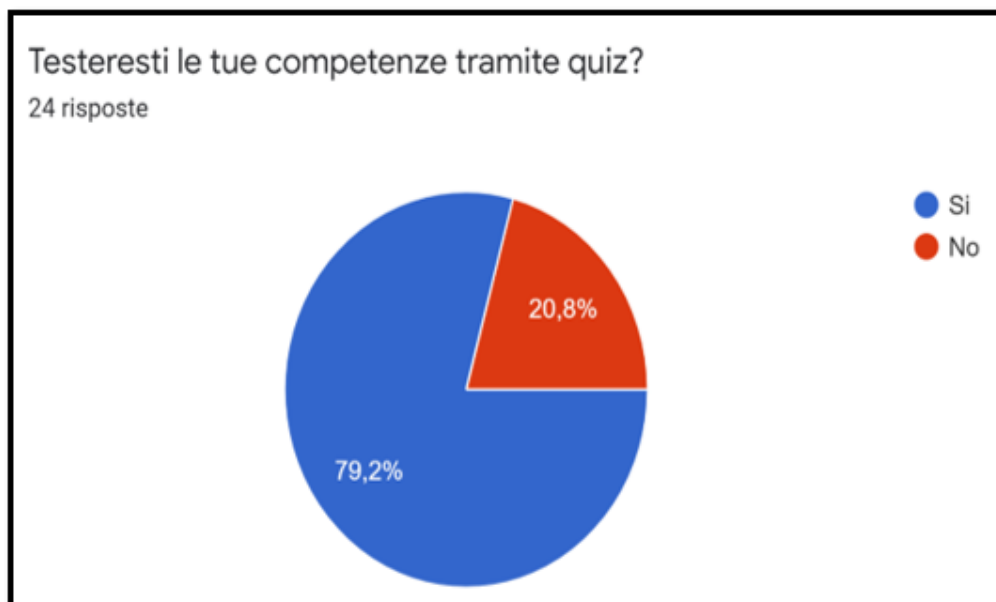
Figure 30: Quiz Generator feature feedback

In the following plot (**Figure 31**) the usefulness of the social component is evaluated. It is interesting to note that half of the test users would use this feature mainly to interface with other users with similar skills, confirming the possible desirability of the user clustering feature.
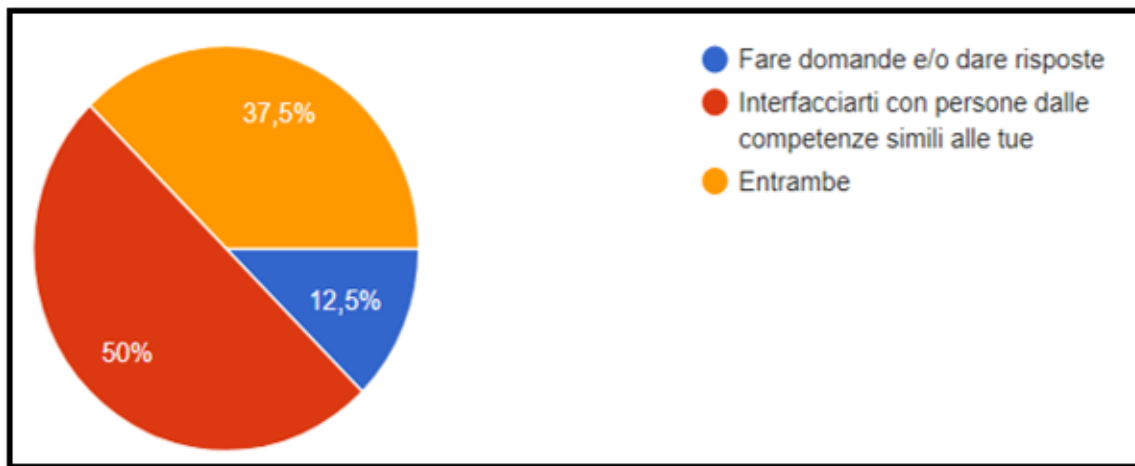
Figure 31: Social Component Feature feedback

This last graph (**Figure 32)** shows the interest in the feature ai agenda. It is possible to notice how the feedback is not totally positive, with a distribution of values concentrated on intermediate values of the scale.

This data suggests that this feature should be revised or, in case of further negative tests, eliminated.
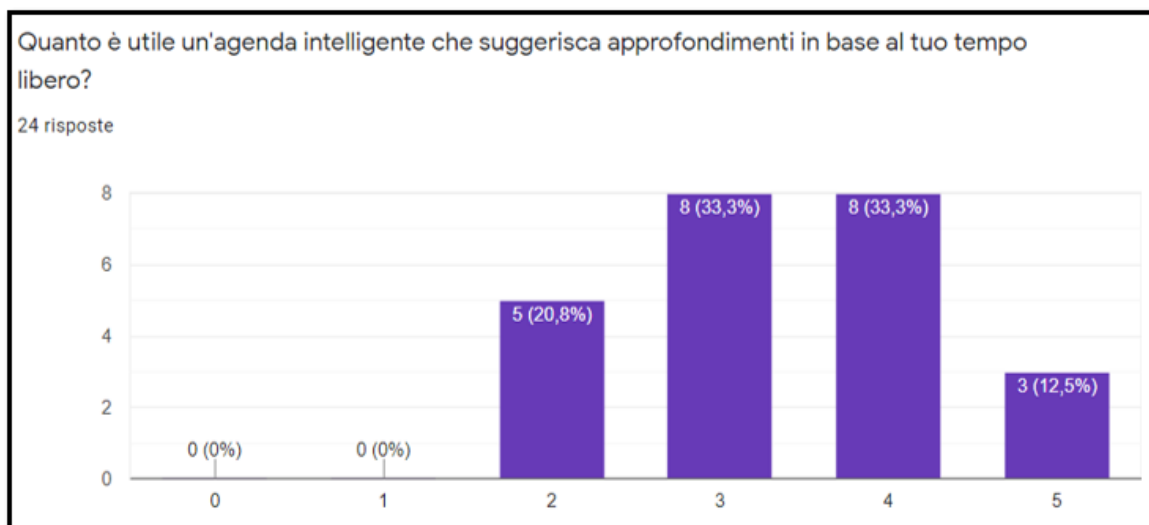
Figure 32: AI Agenda Feature Scores

6.3.2.2 - Live Feedback from Testers

Here is reported an example list of feedback, collected after the test of the Paper Pretotype.

- «Add a way to compare different positions' skill requirements» - S.
- «Inserting all my plans in the agenda would be annoying» - L.
- «Add a login through LinkedIn, I already have my skills there» - T.
- «Consider different skill levels, ex: Python 1/3, Java 2/3, etc.» - M.
- «Provide proofs and/or explanations for the skill forecast» - A.
- «Focus more on the self-improvement part rather than the company-matching part» - R.

- «Can you put information about salary? Maybe show how much more I would earn if I learned a certain skill» - T.
- «Some features of the A.I. interview should not be advertised (ex: stress level recognition), or they could make the user anxious» - L.

The following **Table 30** summarizes the implementation costs in terms of money and time.

Pretotype	Realization Time	Cost	Test Time
Fake Door	3 hours	€8	24 hours
Paper pre-totype	2 hours	Free	2 days
		Total	
		€8	3 days

Table 30: Pretotyping Phase Summary table

Chapter 7 - Conclusions

The testing phase has shown how the entire design process has led to the creation of a product based on data and machine learning that has aroused some interest with the users who have interacted with it.

There are some aspects of the product to be **redefined** (e.g. the AI agenda), but the idea is generally appreciated.

To further validate the product other pretotypes could be realized, with the possible use of hybrid or real data to simulate a concrete use and collect even more metrics and feedback with a goal of continuous improvement.

In the next final diagram **(Figure 33)**, we propose a flow of **possible stages to follow** until the final product release.
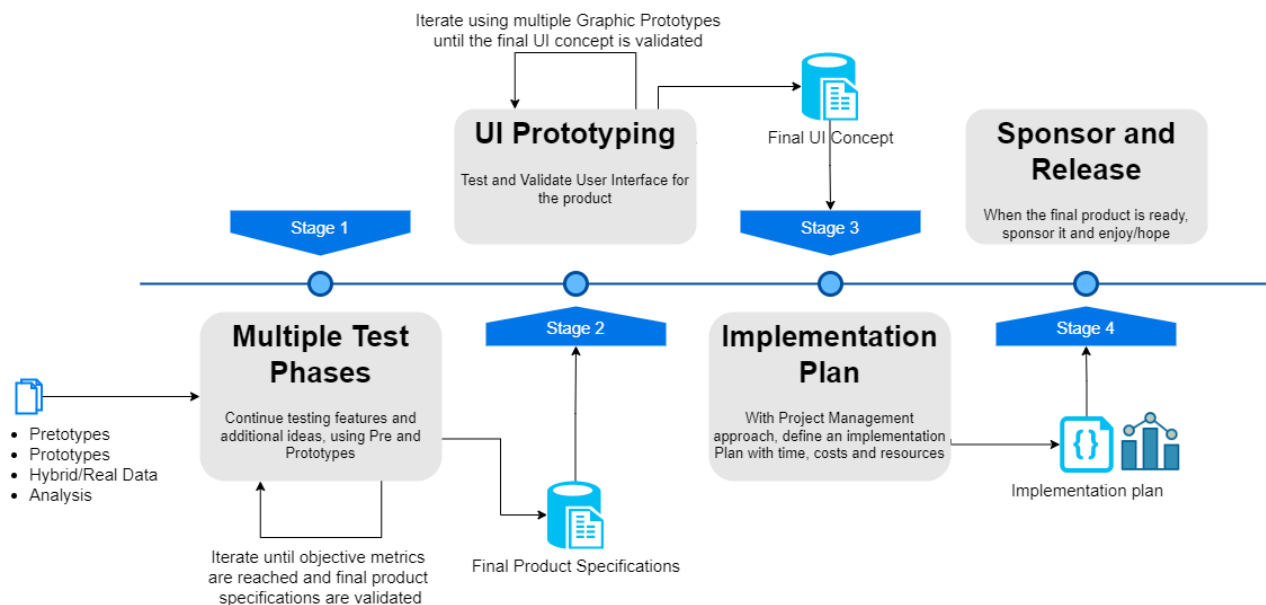
Figure 33: Final Steps until Product Release

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Please note: references marked with an * are not mentioned in the report, but are instead examples of sources analyzed to conduct researches during the process.

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