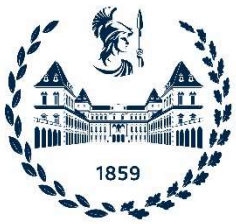

Politecnico di Torino

Politecnico di Torino

Laurea Magistrale in Ingegneria Gestionale
A.a. 2021/2022
Marzo 2022

Servizi basati sull'AI per aiutare i maturandi italiani nella loro transizione post scuola superiore

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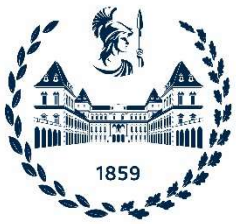

Politecnico di Torino

Politecnico di Torino

Master of Science in Management Engineering
A.a. 2021/2022
March 2022

AI-based services to help Italian high school seniors in their post-high school transition

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Author’s declaration of originality

I hereby certify that I am the sole author of this thesis. All the used materials, references to the literature and the work of others have been referred to. This thesis has not been presented for examination anywhere else.

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08.03.2022

Abstract

The post-high school choice is a very important decision for a young person, as it determines his or her prospects in working and social life. In Italy, this transition is quite problematic, considering the percentage of young people who are not engaged in education, employment, or training (NEET). Italy has the highest percentage of NEETs in all of Europe, with an amount of 27.1% for young people between the ages of 20 and 24. It is almost double the average percentage of countries belonging to the Organization for Economic Cooperation and Development (OECD). This situation is even more serious in southern Italy, where the percentage of NEETs is over 30%. Finding a solution to this Italian youth crisis is not only a goal, but it is a necessity to meet the goals for sustainable development of "The New Agenda 2030", which aims to prevent youth distress in all its forms. The purpose of the case study is to understand if and how artificial intelligence (AI) can solve this problem, creating services that can help students during the post-high school transition. The study shows what are the critical and favorable aspects of AI implementation in the current Italian context, with PEST analysis and interviews with key stakeholders. The results of the case study highlighted the complexity of implementing AI-based services at a national level, due to the heterogeneity that emerged among different high school institutions both from a digital point of view and from student data management point of view.

This thesis is written in English and is 71 pages long, including 8 chapters and 2 figures.

Sommario

La scelta del proprio futuro dopo la scuola superiore è una decisione molto importante per un giovane, in quanto determina le sue prospettive di vita lavorativa e sociale. In Italia questa transizione risulta essere abbastanza problematica, considerando la percentuale di giovani che non sono impegnati nello studio, né nel lavoro, né nella formazione (NEET). Infatti, l'Italia registra la più alta percentuale di NEET in tutta Europa, con un ammontare del 27,1% per i ragazzi compresi tra i 20 e i 24 anni, quasi più del doppio della percentuale media dei paesi appartenenti all'organizzazione per la cooperazione e lo sviluppo economico (OECD). Questa situazione è ancora più grave nel sud Italia, dove la percentuale di NEET va oltre al 30%. Trovare una soluzione a questa crisi giovanile italiana non è solo un obiettivo, ma è una necessità per poter rispettare gli obiettivi per lo sviluppo sostenibile di "La Nuova Agenda 2030", che vuole prevenire il disagio giovanile in tutte le sue forme. Lo scopo del caso di studio è quello di capire se e come l'intelligenza artificiale (AI) possa risolvere questo problema, creando dei servizi che possano aiutare gli studenti durante la transizione post scuola superiore. Lo studio mostra quali sono gli aspetti critici e quelli favorevoli all'implementazione dell'AI nell'attuale contesto italiano, attraverso l'uso di analisi PEST e di interviste ai principali stakeholders. I risultati del caso di studio hanno evidenziato la complessità di implementare servizi basati sull'AI a livello nazionale, a causa dell'eterogeneità emersa tra i diversi istituti di scuola superiore sia dal punto di vista digitale che dal punto di vista della gestione dei dati degli studenti.

Questa tesi è scritta in inglese ed è lunga 71 pagine, includendo 8 capitoli e 2 figure.

List of abbreviations and terms

NEET	Neither in Employment nor in Education or Training
OECD	Organization for Economic Co-operation and Development
SDG	Sustainable Development Goals
UN	United Nation
VET	Vocational Education and Training
AI	Artificial Intelligence
MIUR	Ministry of Education, University, and Research
PEST	Political, Economic, Social, and Technological
PCTO	*Percorsi per le Competenze Trasversali e per l'Orientamento*
AFAM	*Alta Formazione Artistica, Musica e Coreutica*
ITS	*Istituti Tecnici Superiori*
EAA	European Alliance for Apprenticeships
WBL	Work-Based Learning
PTOF	*Piano Triennale dell'Offerta Formativa*
NLU	Natural Language Understanding
NLP	Natural Language Processing
ML	Machine Learning
NN	Neural Network
GDPR	General Data Protection Regulation
IDC	Interest Driving Creator
DBAs	Digitally Based Assessments
CAAS	Career Adapt-Abilities Scale-Italian Form
EHIS	Estonian Education Information System
CDSE	Career Decision-making Self-Efficacy
DSR	Design Science Research

IS	Information Systems
CAQDAS	Computer Assisted Qualitative Data Analysis Software
PNSD	*Piano Nazionale Scuola Digitale*
OGD	Open Government Data

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1 Introduction

1.1 Problem Assessment

The Italian education system has been in a condition that does not live up to the expectation of such an influential state on a global and European level, being a member of G7 and G20. Despite the great cultural background of the Italian school, the Italian boot is one of the European states with the worst performance indicators for education. This serious situation concerns above all the young people of Italian society, who are increasingly neglected by government policies, but who represent the engine of the future economy (Ferlini, 2022). The most worrying statistic is certainly the one concerning young people Not engaged in Employment, Education, or Training (NEET) which sees Italy with the highest percentage in Europe. The NEET percentage of people from 15 to 29 years old amounts to 23,5%, much higher than the average of the Organization for Economic Co-operation and Development (OECD) countries, which amounts to 13,4% (OECD, 2021). If we consider people from 20 to 24 years old, the percentage increases to 27,1%. Furthermore, this percentage is distributed in a very heterogeneous way within the Italian territory, also highlighting a problem of internal inequality. In northern and in central Italy the NEET percentage are slightly higher than the European average, but in the south, it goes well over twice the European average, going over 30% (AlmaLaurea, 2020). A very worrying data that also goes against the Sustainable Development Goals (SDG) shared by the United Nations (UN) in the 2030 Agenda for Sustainable Development. Indeed, goal number ten of SDG aims to reduce inequality between states and even within states (United, 2015). The percentage of early leavers (young people from 18 to 24 years old) from education and training in Italy amounts to 14,5%, which is higher than the OECD average that amounts to 10,5%. Even this statistic is very heterogeneous in the Italian boot too, with central and northern Italy always having percentages slightly above the OECD average. But in southern Italy there is a peak, reaching a percentage that amounts to almost 19% (AlmaLaurea, 2020). Focusing on the school system without going to analyze other contexts that are not relevant to the research topic, it is clear that an intervention is necessary to meet the objectives of the agenda.

Moreover, education, training, and learning are crucial points for the 2030 Agenda for Sustainable Development to prevent youth distress in all forms (United, 2015). However, Italy is far from meeting these requirements to improve the future of the next generation. Italy is one of the European states with the worst performance indicators for tertiary schools, with a dropout rate that is more than 50%, which is far above the OECD average, which amounts to 31% (Aina, et al., 2018). In Italy, only 27,7% of the people from 25 to 34 years old have a degree, it is one of the lowest in Europe and lower than the OECD average amounting to 44,3% (AlmaLaurea, 2020). From the training point of view, Italian education does not provide a lot of Vocational Education and Training (VET) opportunities to students after high school (AlmaLaurea, 2020). For this reason, young people have some difficulties entering the world of work, which is hardly inclusive. Inclusiveness is precisely one of the prerogatives for SDG number four, whose goal is to provide quality, equitable and inclusive education (United, 2015). This situation, therefore, leads to a high rate of youth unemployment after graduation, which is the second-worst, only behind Greece. In Italy, the unemployment rate of young people from 15 to 24 years old is 28%, the third-worst in Europe after Greece and Spain, and above the OECD average is 11,8% (OECD, 2022). Furthermore, the unemployment rate after less than two years of post-high school graduation is 45,1%, and between two and three years of post-high school graduation is 29,8% (OECD, 2021). In this way, Italy would seem to be far from achieving SDG number eight, whose purpose is to promote sustained, inclusive, and sustainable economic growth, with productive employment e decent work for all (United, 2015). In recent years, the Italian government has been trying to intervene in this problem, seeking to increase the offerings of both universities and work orientation programs. In fact, with the report (MIUR, 2014), the orientation of young students has become a central and strategic function in the fight against their dispersion and educational failure. These orientation activities turn out to be very general and heterogeneous throughout Italy, so more importance is given to the universities and faculties with the highest reputation. Therefore, a possible innovative solution could be to use new technologies to make these activities more relevant to the interests and aptitudes of individual students. Creating AI-based services for high school seniors to help them navigate possible paths after high school can certainly be one such solution, although little research has been done on the subject.

1.2 Research Motivation

The picture described in the previous chapter shows the problem of the crisis in which the new Italian generation lives. Unfortunately, today's young people are victims of the political choices made in the past and of a lack of strategic vision at the government level, due to the sudden changes in the executive branch. In Italy there is always a tendency to shift the blame onto young people, continuing to say that they don't want to do anything and that they waste their time on social networks or video games. Perhaps in part, this is true, but it is a condition that concerns a bit all the Italian population, which spends more and more time and money to idle and consume goods and services of no first necessity (Ricolfi, 2019). No one is doing anything to help the next generation figure out what is best for their path to the future, which therefore are often abandoned and neglected by both society and government. Also because the future is increasingly uncertain for everyone and especially for young people who still have to enter the workforce and find their place in society. The plurality of university paths that have been created in recent years has certainly created new opportunities. The fact of having a wide range of choices of paths to take certainly does not make it easier for young students to make a decision but makes them even more confused. As a result, it is necessary to do something to guide today's young students to find their place in society, giving them the opportunity to find a job that satisfies them and is of interest to them. Thesis research was conducted regarding the most relevant technologies to succeed in this endeavor. The technology on which the study is conducted is Artificial Intelligence (AI). It was identified through brainstorming performed with supervisors and expert researchers from Tallinn University of Technology that best fits the final goal of the thesis work. As will be discussed in more detail in the following chapters, AI can be used to create services to help high school seniors to find their path post-high school. Indeed, AI is a technology that allows calculating user profiles by taking some user data as input, to predict in a customized way what can be the path that best suits the interests and attitudes of the young students.

1.3 Research question, Objectives, and Hypothesis

The problem assessment describes the seriousness of the next-generation problem and how it must be addressed if the state is to achieve economic and social growth. This study seeks to understand if and how the Italian government could use AI technology to solve the young people crisis and to help students in the post-high school transition. The

government did not make any research or decision in this technology path to help young students. Thus, it is necessary to analyze how the Italian Education system and government are moving to solve this problem, and how the decision-making process of high school seniors is. It is important to know how all the stakeholders, physical and institutional, are involved during this high school seniors' transition. To investigate the implementation of AI-based services in the Italian education system, the main research question is identified: *How can AI-based services help Italian high school seniors in their post-high school transition?* To answer this general research question, other three research questions are found, dividing the macro topic into three subtopics:

- *RQ1: How is the current situation of the post-high school transition in the Italian educational system?*

To answer this question, a PEST (political, economic, social, and technology) analysis is used. Indeed, the other four sub-questions are formed to give a detailed background of the Italian educational system's current situation.

    - *SQ1: What policy choices have impacted the post-high school transition in the current Italian educational system?*

This question is used to detect the past policies from the Italian government, which influenced the current context about the transition post-high school.

    - *SQ2: What are the economic consequences and causes of the current Italian educational system?*

This question is used to examine the government investment in education and the relations between the education system and the economy of Italy.

    - *SQ3: What are the social factors involved during the post-high school transition of the current Italian educational system?*

This question is used to see which social factors are important in the decision-making process of the high school seniors and which and how stakeholders influenced the final choice.

- *SQ4: What are technologies used and what could be used during the post-high school transition of the current Italian educational system?*

This question is used to analyze the technological state of the art of the Italian educational system to figure out if it could be progressive enough to interoperate with AI-based services. The objective of this first research question is to collect important and detailed information to have an in-deep understanding of how the transition post-high school is. From this information, it will be more understandable what changes need to be made and what features are suitable for developing AI-based services. The hypothesis to be tested related to this research question is that the current Italian context is inclined to the introduction of AI in the educational system.

- *RQ2: How is students' data stored in Italian high schools?*

To be able to fully answer this question, three additional sub-questions are identified:

- *SQ1: What is students' data stored in Italian high schools?*
- *SQ2: Where is students' data stored in Italian high schools?*
- *SQ3: What is students' data needed for the predictive algorithm?*

The objective of this second research question is to examine the accessibility and the management of the students' data of the current Italian educational system. Answering this question will allow us to understand if the data stored in the school system contain the student information needed to create an efficient predictive algorithm. It is important to know where these data are stored and figure out how it is possible to access them, also respecting students' privacy. The hypothesis to be tested related to this research question is that the data infrastructure of the Italian school system can enable the implementation of AI-based services.

- *RQ3: How can the implementation of AI-based services improve the projects processes related to the post-high school transition?*

Other two sub-questions are identified to respond to the third research question:

- *SQ1: What are the main issues in post-high school transition orientation activities?*

- *SQ2: What are the main issues in the PCTO project, both students' and professors' sides?*

The objective of the latter research question is to identify any patterns within the students' decision-making process. As will be discussed in the following chapters, post-high school orientation is very diverse and very different based on many variables. Finding standards within this process is critical to being able to set up AI-based services. Moreover, a particular analysis is made on the project of the formative job orientation "*Percorsi per le competenze trasversali e per l'orientamento*" (translated into "paths for transversal competencies and orientation"), also known as PCTO. The hypothesis to be tested with this research question is that AI can enhance and facilitate the processes of orientation programs and the PCTO project. Through these research questions, it is possible to determine the main purpose of the study that is to understand if the implementation of AI-based services is feasible within the current Italian educational system. If not, what can be done to bring an innovative solution to solve this crisis for young Italians.

2 Research methodology

At the beginning of the thesis study an in-depth overview of the crisis of Italian youth people was conducted, to have a clearer idea about it. The information found in different sources showed a serious problem among Italian students in decisions regarding their future, highlighting a clear difficulty in integrating into society. After some research, a gap in the academic literature emerged and only a few scientific articles speak about the implementation of AI services in the education system. Considering the high potential of AI technology to provide quality suggestions in a way that is personalized to each youth and given that the field appears to be unexplored, it was decided to undertake this thesis project. The main research question aims to understand if and how AI-based services could help Italian young people to find their path. Each methodology has advantages and disadvantages in research, and it depends upon three main conditions: the type of research question; the control that the researcher has over the problem analyzed; and the focus on contemporary phenomena (Yin, 2009). Since the main research question begins with "how," according to (Halring, 2012), a qualitative research method must be used for this study. For this reason, two main qualitative research methodologies were examined: design science research (DSR) and case study research. DSR is a research methodology that aims to create new artifacts that are effective in solving real-life problems (Prat, et al., s.d.). DSR in Information Systems (IS) focuses on the creation and evaluation of innovative artifacts that enable organizations and institutions to address important information-related tasks (Hevner, et al., 2004). The artifacts built with this methodology can be represented by constructs, models, methods, or instantiations. The process through which is possible to create these artifacts is made of six steps: problem identification and motivation, the definition of the objective for a solution, design and development, demonstration, evaluation, and communication. There are several starting points for the DSR such as a problem-centered initiation, objective-centered solution, design and development-centered initiation, and client/context initiation (Brock, et al., 2020). All these characteristics seem to meet the needs required by the thesis study and therefore this research methodology was considered. However, innovative solutions are usually

created by existing theories and artifacts. DSR combines, revises, and extends the existing design knowledge to find a solution to the problem. The solutions derived from this methodology often have to overemphasize technological artifacts, neglecting the theoretical knowledge. Considering the academic gap in the topic, the DSR does not seem to be the best method. The few scientific articles and research found on the topic are not sufficient to successfully apply this method. Furthermore, the goal of the thesis study is not to build an artifact but to understand the feasibility of AI-based services implementation in the actual Italian education system. For these reasons, it was decided not to opt for DSR methodology and to adopt the case study research method. In general case study is a preferred method when the main research question starts with "how" and the researcher has little control over the events. Another important aspect that led to this decision is the fact that the topic focuses on a contemporary phenomenon within a real-life context. As reported in (Halring, 2012) "case study is a holistic inquiry that investigates a contemporary phenomenon within its natural context". A phenomenon is the unit of study, and it can mean several things such as programs, events, activities, problems, or individuals. The process of case study research is based on five important steps: defining the case; selecting the case(s); collecting and analyzing the data; interpreting data; and reporting the findings (Crowe, et al., 2011). The unit of study is analyzed in a bound system in terms of place, times, processes, and events, to find what is relevant and workable. It is very important to define the boundary such as social group, geographic area of interest, the types of evidence, and priorities for data collection and analysis (Crowe, et al., 2011). Case study research is a qualitative research approach that can be conducted through several data sources, such as primary research, reports, direct observation, or scientific articles. Data collection might be focused more on quality than quantity, to have data that are rich in content, and because it is a crucial stage of the method (Halring, 2012). Moreover, data need to be organized and coded to allow it to be easily retrieved during the analysis phase (Crowe, et al., 2011). There are three different typologies of case study: intrinsic case study consists of the specific case study; instrumental case study, used to provide a general understanding of a phenomenon using a particular case; and collective case study, also known as an analytical generalization, which uses instrumental case studies that occur on the same side, involving different stakeholders and multiple cases (Farquhar, 2012). The latter case study turns out to be perfect for the topic analyzed, for the presence of several stakeholders and multiple cases.

2.1 Case study design

The first task of the case study design is to define the case study and to decide the unit of study. Improving the condition of youth Italian people is a huge topic and it was necessary to set a bound system (Crowe, et al., 2011). The selected case study concerns the Italian educational system and in particular the post-high school transition activity. This choice was made downstream of the information found during the first thorough overview of the problem. Indeed, the data show a clear difficulty on the part of young Italian students to find their path, evidenced by a high percentage of NEET and high dropout rates. The unit of study involves multiple case studies and several stakeholders, and for this reason, it is a collective case study (Farquhar, 2012). There are different activities that students can do to gather information about their future path during the post-high school transition, such as university orientation activities and job orientation activities. All the stakeholders involved in these activities are students, high-school professors, universities, parents, AI technology experts and companies. The objectives of this case study are to explore, describe and explain the feasibility of the AI-based services implementation to help high school seniors in their post-high school transition (Farquhar, 2012). By exploring and describing the actual situation of the Italian educational system, it is possible to explain whether AI-based services could personalize the flow of information for each student, based on his or her interests and aptitudes. The researcher has an interpretative role, analyzing and synthesizing the collected data. These important tasks must be conducted objectively and without some cognitive bias (Halring, 2012).

2.1.1 Case study design: data collection

Data collection is one of the crucial phases of the case study research method. It is important to focus on highly meaningful and quality data since a qualitative methodology is used. Secondary research is used for the in-depth overview of the case study. The free access to the Tallinn University of Technology Library allowed the researcher to find scientific articles, reports, journals, and documents highly relevant to the topic. Instead, primary research is used to collect highly meaningful information, which is very important for a qualitative method such as a case study. The data source adopted in this primary research is the interviews through telecommunication tools such as google meet, zoom, or skype. The sample chosen best must represent all stakeholders involved in the study unit, for the information gleaned from the interviews to be sufficiently satisfactory.

The sample size in a case study is usually small (Schoch, 2020) and for this research, it was possible to conduct twenty-five interviews, including different stakeholders. In this sample there are: university students or graduate students that changed university path in the past years; ex-university students that decided to drop out the university; graduate students who have reached the end of their university path without any problem; high school seniors who must decide his or her future; high school professors who teach to seniors students' classes; high school professors involved in PCTO project; high school manager of university orientation program; high school manager of PCTO project; AI technology experts. The sampling technique that was used in this research is convenience sampling. This was studied during Innovation Management and Product Development course at Polytechnic of Turin during the Innovation Management Engineering master. This convenience sampling consists of selecting an easy-to-reach sample through knowledge people, starting from friends and professors from the province of Verbano-Cusio-Ossola (Italy). The snowball effect sampling was used to expand the number of people, asking the respondents to involve other respondents. Moreover, Tallinn University of technology allowed to organize a workshop with AI technology researcher, to have a better understanding of the possible implementation and issues of the case study. Interview protocols are essential to ensure consistency across interviewed people and they consist of a list of questions (Schoch, 2020). Furthermore, it is required to use different interview protocols for each stakeholder who must be interviewed. The development of these lists of questions was done by considering the goals to be achieved through the research questions and collaboration with experts in education system innovation. This collaboration was established with the American association called RoboRAVE Intl. This association aims to introduce the teaching of artificial intelligence in schools worldwide. The founder of the association showed himself immediately available and interested in collaborating on the research. It was possible to determine the questions to be developed for each stakeholder through two video calls that took place with zoom (see Appendix 3 and Appendix 4). The structure of the interviews was translated into the Italian language since the interviews were conducted with Italian stakeholders.

2.1.2 Case study design: data analysis

Secondary research is used to gathered information for the PEST analysis, which is an acronym for political, economic, social, and technological factors (Chapman, 2011). The objective of PEST analysis is to understand how and which the factors influenced the current situation of the post-high school transition. What policies have affected the

decline in statistics regarding the unit of study. What economic factors have affected the performance of post-high school transition. What social factors influence high school seniors' choices regarding their future path. What AI-related trends can positively impact its implementation to help students during the post-high school transition (Chapman, 2011). Instead, interviews collected through the interview protocols for each stakeholder need to be analyzed. The data analysis phase in qualitative research is based on two different processes: codifying and categorizing (Saldana, 2008). The interviews conducted in the case study need two previous processes before being analyzed: transcription of the interviews and translation (Saldana, 2008). The transcription process consists of writing down the interviews conducted using the notes taken during the interviews and their video call recordings. The transcribed interviews were then translated into English as they were conducted in Italian to facilitate dialogue with stakeholders and avoid missing important information. These two tasks are very important for the following phases of the research and the success of the entire research. Indeed, a mistake in this step entails its propagation to the rest of the work, compromising the result. The translation process was performed with the help of online translation tools with excellent reviews (such as DeepL translator and WordReference) to make this work less time-consuming for the researcher. During the translation phase, it is possible to perform pre-coding, in which the parts of the interview that are considered important for the actual analysis phase are underlined. The type of coding used for this case study is descriptive coding. This method enables to organize and group similarly coded data into categories because they share some characteristics (Saldana, 2008). This analytic method is formed by decoding, in which the core meaning of data is deciphered, and encoding, in which the data labels are determined. Analyzing interviews with a coding methodology means looking for patterns among stakeholder responses. Patterns can be characterized by similarity, difference, frequency, sequence, correspondence, and causation (Saldana, 2008). To be able to find patterns in the data, it is necessary to develop rules in the form of propositional statements among the categories. The categories identified during the categorizing process must be reworked to find the major themes or concepts. There is no standardization of this process and therefore no set number needed to be found to perform an optimal analysis. The number of codes, categories, and concepts is subjective and varies between different research (Saldana, 2008).

2.1.3 Case study design: data analysis implementation

There is software that can be used by researchers to conduct a case study analysis. This software is also known as Computer Assisted Qualitative Data Analysis Software (CAQDAS). CAQDAS allows to store, organize, manage, and reconfigure the data collected from the interviews, to enable the research analysis (Saldana, 2008). After doing a cost analysis of the various CAQDAS available online, it was decided to opt for an alternative way given their high costs. The researcher programmed excel sheets through skills developed during years of Innovation Management Engineering at Polytechnic of Turin. Taking as reference what is reported in the article (Saldana, 2008) and the websites of the analyzed software (ATLAS.ti, 2022) (International, 2022) (MAXQDA, 2022), the researcher tried to replicate the analytical tools through the use of pivot tables on excel. Three columns were realized for each interview: in the right one is reported the text of interviews, with the questions and related stakeholders' answers; in the middle one is reported the coded data from interviews, using different colors to distinguish the parts of the text that a code refers to; the categories related to each coded data are reported in the left column. A pivot table is created for each interview using the identified categories and important parameters for the analysis as filters. For the university students, the parameter of participation in the PCTO project was also included in addition to gender since it is a new project in the educational system and not everyone has performed. Instead, parameters were included regarding involvement in college orientation projects or the PCTO project for high school professors. In this way, it was possible to adapt an excel sheet for the qualitative analysis of the case study.

3 Background

To understand in detail how high school seniors' decision-making process of university or career path takes place, it is necessary to make a brief introduction to the Italian school system, the university orientation projects, and the job orientation projects. This introduction is relevant for the final paper since each state of Europe has its structure of the educational system that is different from the others. It was possible to obtain this information through dialogues with students from different countries of the world during the case study work done abroad. This showed a clear diversity of European educational systems, especially in the transition from primary and secondary school, where the age of transition changes a lot, with a range from 10 years old (for example happens in Germany) to 16 years old (for example happens in Estonia) (Commission, 2018). Furthermore, it is necessary to introduce AI technology, to understand the process to develop a predictive model that can be used for the implementation in this case study.

3.1 Italian Education System

Education in Italy is regulated by the Ministry of Education, University and Research (MIUR), it starts from a non-compulsory integrated system from zero to six years old. According to what is reported on the website of the MIUR (MIUR, s.d.), it is composed of educational services for infants and preschools. The educational services for infants are managed by local authorities, other public bodies, or private individuals, which take in children between the ages of three and thirty-six months. The preschools are managed by the State, local authorities, other public bodies, or private individuals, and these facilities are for children between the ages of three and six years. Once the student has completed preschool, compulsory schooling begins, which is ten years in length. It is characterized by the first cycle of education, which is the same for all students and is divided into elementary school, for a duration of five years, and first-degree secondary school, for a duration of three years. At the end of the eighth year of compulsory school, the student must face the first major choice within their tracking

school, before the beginning of the second cycle of education. In fact, at this stage, the student can choose between two alternatives: second-degree secondary school or vocational education and training paths. Students are primarily oriented with activities organized by middle schools in collaboration with high schools in the area, to give them an idea of the various opportunities they may have. In addition, students can find information on their own on the internet, consulting the official website of the MIUR (MIUR, 2021), or other sites that offer orientation tests to understand which school best suits the characteristics of the student (Studenti.it, 2021). The second-degree secondary school is divided into three typologies of high schools, all with a duration of five years. Technical institutes ("*Istituti Tecnici*") are characterized by a solid cultural base of scientific and technological character in line with the indications of the European Union. Technical institutes aim to teach students the knowledge and skills necessary for a rapid entry into the world of work and access to university (Italy, s.d.). They concern the exercise of technical professions with an organic connection between the high school and the companies of the surrounding area through internships, apprenticeships and the "*alternanza scuola-lavoro*" project ("alternation school-work") (Galli, 2012), now called "*Percorsi per le competenze trasversali e per l'orientamento*" (PCTO, which means education and training in soft life skills and students' orientation) (Ministery of Education, 2021). Professional institutes ("*Istituti Professionali*") are characterized by a solid base of general and technical-professional education. This institute typology allows students to develop knowledge and skills necessary to meet the training needs of the productive sector of reference, for a rapid entry into the world of work, and access to university (Italy, s.d.). All this is possible through laboratory activities, internships, apprenticeships, and the PCTO project (Ministery of Education, 2021). The gymnasiums ("*Licei*") are characterized by a less technical basis than the two previous typologies and more theoretical. This institute typology aims to provide students with the cultural and methodological tools for an in-depth understanding of reality and to learn knowledge, skills, and competencies consistent with personal abilities and appropriate for the pursuit of higher studies (Italy, s.d.). The vocational education and training paths are managed by the regions and have a duration of three or four years. The purpose of these institutes is to provide the skills and technical knowledge such as to be able to easily insert students into the job world, thanks to the relationship between the region and the local industrial realities. In addition, students who undertake the latter tracking school can also enter

the universities, integrating the knowledge gap at private or state institutions that provide specialized programs for this type of student. At the end of the second cycle of education, the student must decide his or her future based on the skills and knowledge developed during the years of education and based on the information available to him or her, provided by the student orientation projects (which will be discussed in next chapter). At this decision-making stage, the student can continue his or her studies by enrolling in a Bachelor's degree program at a university, in "*Alta Formazione Artistica, Musica e Coreutica*" (AFAM), if the student is inclined towards music, or in a course offered by "*Istituti Tecnici Superiori*" (ITS), to professionalize a student in a specific job (MIUR, s.d.). Orientation activities regarding the post-high school transition will precisely be covered in detail in the next chapter, where we will explain in detail where students can gather the information, they need to make this decision. Furthermore, if the student takes the university route, at the end of the bachelor's degree he can continue his studies with a master's degree.

3.2 University Orientation Program

University orientation is an essential service for high school students to provide the information they need for the decision-making process on which path to take once they finish high school. As is reported in the report (MIUR, 2014), orientation is a set of activities that enables teens to identify their interests, skills, and competencies so that they can make more knowledgeable educational and vocational decisions. In Italy, orientation is entrusted directly to the high schools, which have the task of orienting their students, creating an internal organizational structure, headed by an orientation manager. This orientation manager is responsible for establishing and maintaining relationships with universities and local businesses. The purpose of the local orientation activities is to provide students information about the local economic situation and the possible opportunities for work. Instead, the orientation activities reported within the document (MIUR, 2014) are: the formative orientation or didactic orientation and the activity of accompaniment and orientation consulting. The first activity consists of disciplinary learning, aimed at the acquisition of basic knowledge, cognitive, logical, and methodological skills. The second activity is carried out by high school teachers, who have the task of assessing the students, informing them about the possible professional outlets and training paths, also based on what the labor market

requires. Therefore, for the accompanying activities, the presence of the orientation manager is necessary, capable of coordinating the orientation activities and interfacing continuously with external parties to be involved in these activities. An interview with an orientation manager from an Italian school from the province Verbano-Cusio-Ossola (Italy) and the MIUR document (MIUR, 2014) allowed me to understand the orientation manager's work in more detail. The orientation manager must organize orientation activities in collaboration with universities considering the inherent nature of the high school curriculum. One activity is the open day, in which students can go and visit the universities after they have been notified of the event by their high school. On this orientation day, universities organize different stands to give information about the different faculties present within the university to interested students. With the advent of covid, this orientation project necessarily had to change format given the restrictions of moving and gathering. Therefore, universities have adopted the use of virtual classrooms, organized directly with high schools during out-of-school hours, to be able to give information about educational offerings to high school seniors. Another activity is the student fairs, in which the institutes of a village organize an orientation day with different universities, which organize their presentation through a representative, which is often a professor. This activity allows students to get information from different universities of different addresses, so they can have their own opinion on the various educational paths. Furthermore, the orientation manager will need to participate in orientation training and keep updated, to be able to offer adequate support to students. Moreover, high school seniors, who are interested in pursuing their studies in tertiary school, can search for general information about the university faculties on the website (MIUR, 2021). The website provided by MIUR offers listings where students can learn more about the university system, academic careers, educational offerings, various professions, international mobility opportunities, and more. Also, MIUR provides information from another web portal (MIUR, 2021), called Universitaly, to give universities' general information to students and their parents. The website design is divided into four macro topics: students, parents, high schools, and universities. In this way, every stakeholder involved in the post-high school decision-making process can navigate through the site to search for the information they need from their perspective. Students can see if their level of preparation is sufficient to enter science degrees, or even see where the locations are that offer their chosen educational pathway. In addition, the students and

professors can find a detailed description of all the various post-high school paths proposed by the Italian educational system and the opportunities they offer. On the other hand, parents can browse the MIUR website to get updates regarding the various study paths offered by Italian universities today, understand the geographical location of the universities, and the various costs of university fees. Parents are very important for the formation of students and are co-responsible in the orientation actions promoted by the high school. Therefore, the students' parents must be always updated not only through a web page but also with training courses on the accompaniment of students and with psychological counseling in cases of risk or school dropout (MIUR, 2014). Furthermore, the students can find some psycho-aptitude and cultural tests online (UniCusano, 2021) (Università.it, 2021) (Studenti.it, 2021), but no school requires its students to do them. The test aims to show students' aptitudes and characteristics, to see what academic path is better. The results are calculated through the students' answers to the tests, thanks to an algorithm based on factorial analysis that can provide a psycho-attitude profile of the student (Sirigatti, et al., 1997).

3.3 Job Orientation Program

The introduction of work within the students' education is involving many European states in recent years, also thanks to the European Alliance for Apprenticeships (EAA). EAA aims to improve on-the-job learning for European students through the alternance of schoolwork (Gentili, 2016). Work-Based Learning (WBL) and Work-Related Learning experiences allow students to apply the theory learned in school and develop new hard skills and soft skills, useful for students' careers (Sicurello, 2016). Learning-by-doing methodology and situated learning methodology are applied to enhance the personal interests of students and to facilitate an active, autonomous, and responsible participation in society and not only in the academic context (MIUR, 2018). Italy joined EAA in July 2015, with the so-called "*Buona Scuola*" law (law 107/2015), thanks to which compulsory alternance schoolwork was introduced in all second-degree secondary schools. With this law, students at technical and professional institutes were obliged to complete 400 hours of internship over the last three years, and in the gymnasium, there was an obligation of 200 hours, again spread over the last three years (Gentili, 2016). With the 2019 budget law, the alternance school-work project changed its name to "*Percorsi per le competenze trasversali e per*

l'orientamento" (translated into "paths for transversal competencies and orientation"), also known as PCTO and this is described in detail in the next section. Another project aimed at the job orientation is the Job Shadow, in which students decide to go and see a professional in the job they are interested in for an entire day. This project is aligned with the purpose of the orientation of the MIUR (MIUR, 2014), which wants to create laboratories or projects in school contests to improve the career management skills of the students, with the involvement of the professionals.

3.4 PCTO Project

PCTO project led to a major change in the number of hours dedicated to alternance schoolwork activities for each institution: 90 hours in the final three years for gymnasium, 150 hours for technical institutes, and 210 hours for professional institutes (Ministery of Education, 2021). The PCTO project allows the student to have an ongoing orientation, allowing them to develop an attitude of greater awareness of their vocations. This experience contributes to have a clearer idea of the social-economic context in which the student grows up, allowing them to understand where they can place themselves in society (MIUR, 2018). Compared to the old alternance schoolwork project, the internal organizational structure of the high schools has remained virtually unchanged. The project is always managed by a manager, called PCTO manager now, who is an internal professor at the high school who has chosen to serve in the role of manager. An interview with the PCTO project manager of a school in the province of Verbano-Cusio-Ossola (Italy), allowed the researcher to understand in detail his role. His or her task is to coordinate all the various activities that need to be done in the project. First of all, he or she has to make sure that all the guys are following the safety courses provided by the ministry platform because they are essential to be placed in a workplace. In the meantime, the PCTO manager has to interview all the students in all the classes of the institute personally or collectively with the class, to understand their interests from a work perspective. Once the manager has the list with all interests, the PCTO manager must begin contacting companies present in the territory surrounding the institute. These companies should meet the needs of all and to apply the theory that students are learning in their high school address (MIUR, 2018). The PCTO manager must ensure that the development of projects is consistent with the provisions of the "*Piano Triennale dell'Offerta*

Formativa" (PTOF, translated in “Three-Year Plan of Educational Offerings"), signed by the institution itself (MIUR, 2018). It is very important to have skillful stakeholder management to organize PCTO project because with that manager can establish long-lasting relationships with the companies and can best allocate the students. Having a list of companies affiliated with the school saves the PCTO manager time in the work experience research phase. Once the student-company match has been made, the mentors come into play and there are two of them: a company tutor and a high school tutor. The tutors are of paramount importance in the project, as they are responsible for monitoring and evaluating the student's project, through individual or group interviews, with specific grids or rubrics for the project, curated by the class council (MIUR, 2018). To be able to do this job in the best possible way, the two tutors must be in constant contact with each other. Before the start of the project, they must agree on the activities to be done by the student, in coherence with the study path of the high school, the possible outputs of the experience, and the “*Carta dei diritti e dei doveri degli studenti*” (translated in “Charter of Students' Rights and Duties”) (MIUR, 2018). The school mentor must go to view the student's work in person at least one day during the experience, including verifying that the quality and safety standards of the workplace are maintained. The process of evaluating project outcomes is done in a variety of ways, depending on the tools and habits of the high school. Depending on the level of digitization of the institution, it may be decided to adopt tools such as logbooks or digital portfolios present in the school electronic register, which facilitate the exchange of information between the various stakeholders involved (MIUR, 2018). The student must fill out his logbook or digital portfolio with the days and the hours he worked and also the activities he performed during the experience. Conversely, if the high school does not have highly digitized tools, it may have paper scorecards or rubrics, which are filled out by the company's tutor evaluating the student’s activity. These sheets are then handed over to the high school, which is responsible for keeping them in the student's school file so that they can be retrieved. Documents related to the PCTO project will then be analyzed by the PCTO manager, who will be responsible for checking that everything is done according to the standards of procedures and that everything is correct. The data from the work experience will then be available to the student's class committee, which will be held in the final graduation exam. Furthermore, this data is also useful for the preparation of the student's curriculum, in which the activities carried out during the PCTO project are reported (MIUR, 2018).

Indeed, final documents of the PCTO project report on skill levels learned during the experience and verification of achievements. This assumes a formative value, indicating one's vocations and interests, but also promotes self-orientation, since by entering the world of work, one can better evaluate the economic and professional expectations for one's future (MIUR, 2018).

3.5 AI Technology

AI technology is a very trendy topic in the last ten years, this is also underlined by the increase of the total scientific article publications, which is more than quadrupled (Arrieta, et al., 2020). Furthermore, we encounter AI applications every day without realizing it, for example in the social media content, online advertisement, music recommendations, and movie recommendations. All these digital services use AI technology to analyze and elaborate the users' data, to create personalized services, and to offer content that interests the user (Helsisnki, 2018). How the course of Element of AI provided by the University of Helsinki (Helsisnki, 2018) says, there is not an exact definition of AI, because this field is rather being constantly redefined and often new topics emerge in AI. AI is a branch of computer science, where the goal is to create machines with the same function as the human mind, that think and are as intelligent as humans. At the Robotex International Conference held in Tallinn in November 2021, Russ Fisher Ives (president and founder of RoboRAVE Intl) explain in detail the five simple steps of the AI workflow (Ives, 2021). The first step is the data collection, and this is a time-consuming phase (two or three months approximately) because it is characterized by increasingly specific activities. In the beginning, it is necessary to learn how to collect data, that are critical to being able to develop a good model. Once this concept is learnt, it is important to understand how to get quality data and how to have a large amount of this data, around the idea of what you are trying to teach to the AI. The second step of the AI workflow is the label data, a very important process as AI needs to organize and categorize data so that it can be analyzed. The next step is training AI technology with the data and the related labels, which results in a model. The model is a mathematic function, based on a mathematical algorithm that receives input data, elaborates it, and produces an output. The result obtained corresponds to the highest probability that the AI can calculate through the comparison of all input data through a mathematic algorithm. Moreover, even this phase requires two to three months of work

to be able to create an efficient model that produces the desired results. Once the AI is trained with new skills, it is time to define the behavior of the technology. In this step is important to understand how to present the output, considering the interaction with the final user, to build a user-friendly interface in which the output is simple and easy to understand. This AI workflow is continuously repeated to continue to improve and make the technology more efficient. In addition, this workflow can be employed in all sub-branches of AI: computer vision, natural language understanding (NLU), natural language processing (NLP), and machine learning (ML) (Techopedia, 2021). The latter turns out to be the most important for the predictive analysis, which is very important in this research. ML models are used to find patterns and relationships through the present and past data. These data are running by the ML algorithms, which need a dataset to set the parameters, through different types: supervised learning, which used historical labeled data to predict the correct answer; unsupervised learning, which used not labeled data to find a group of data with similar behavior; reinforcement learning, usually used after the learning algorithm and it is for searching patterns (Techopedia, 2021). The ML models most used in the predictive analysis are based on mathematical and statistical models, such as linear/logistic regression, support vector machine, decision tree, k-nearest neighbors, data mining, cluster analysis, and neural network (NN) (Arrieta, et al., 2020).

4 Theoretical Overview

Scientific research conducted in the fields of career counseling and orientation programs is unfortunately very small and often not conducted on the implementation of digital services based on AI (Stina, et al., 2021). In the article (Skorikov, 2007) the authors criticize the fact that the empirical research does not give the suffix attention to the career preparation on the career development, which is very important for the post-high school seniors. The following paragraphs outline the secondary research that has been conducted regarding the implementation of AI technology within the field of education and how it can lead to improvements in the educational sector. The data needed for the system is analyzed through the most important steps in data management and through how the GDPR regularizes the handling of student data. Finally, new theories about guidance programs and how the pandemic has impacted the education system are also described.

4.1 AI Technology in Education

Secondary research conducted on the case study has shown that it is possible to create a system that relies on AI technology and can give some advice about the students' careers based on their interests (Xiaomin, et al., 2019). In this way, the system pushes students to do tasks and activities according to the recommendations of the algorithm, improving their vocational skills and their ability. Thus, students' interests become the most important decision-making factor for their career, to identify what they like to do in life (Xiaomin, et al., 2019). The Interest Driving Creator (IDC) theory can play an important role in guiding innovation in education (Dillenbourg, et al., 2019). Indeed, the implementation of IDC theory through AI technology is especially used to achieve higher quality in teaching through ML, to personalize the curriculum and content of the lessons based on the students' interests, and to find their place in society (Xiao & Yi, 2020). It is used in computer-related technology transitioning to web-based and online intelligent education. Ultimately, it also is used in humanoid robots and web-based chatbots to perform teachers' duties, such as grading students or other administrative functions, that

are very time-consuming (LIJIA, et al., 2020). AI technology could give the professors more time to devote to teaching. Furthermore, guiding students of higher education into the job world is very important, including lifelong learning (Stina, et al., 2021). Career guidance is an important function for this purpose, and digitalization could improve and transform the services and the practices related to this field. It is possible to create career guidance services based on user needs, staff competencies, and organizational capability through AI technology (Stina, et al., 2021). These new digital services would help students to support their career planning, matching them with career counselors, offering self-assessment tools that compare competence with the goals and needs from the work-life. In particular, the figure of the mentor is very important for the young students, providing them practical guidance to improve their university and career planning and job research (Renna, et al., 2014). The AI technology implementation in career guidance would not help only the students but also professors. Indeed, this could help them to better understand the needs of each student so they can provide better learning.

4.1.1 ML in Education

The AI technology branch most commonly implemented in digital services in the education field is ML because it is used principally in predictive analysis (Arrieta, et al., 2020). Indeed, in the education field, the technology is implemented principally to analyze how to reduce the effort of the school personnel and to improve the quality of education. One of the metrics to evaluate the quality of a school institution is the students' school performance, which is possible to predict through random tree algorithm and data mining (Hamoud, et al., 2018). Furthermore, after predicting student performance, it is possible to offer them suggestions and activities to do on how to improve their school performance (Hamoud, et al., 2018). In this way, the overall quality of the institution can be improved. The ML models could be implemented to predict the dropout of high school students through the neural network, support vector machine, and fuzzy ARTMAP. With these three techniques, the prediction is very accurate because the results of each technique it's correlated with the results of the other techniques (Ioanna, et al., 2009). ML is also used to assess student responses through the mood criteria digit decision-making approach (Bidyut, et al., 2021). This new digital service can help professors, reduce their effort and improve their teaching by being able to devote a greater amount of time to it.

4.2 Data Management in Education

Students' data management is a fundamental part of the successful implementation of AI-based services. The lectures of the course "Information Society Principles: towards e-Governance" at Tallinn University of Technology (Velsberg, 2021) (Velsberg, 2021) and the Robotex conference (Ives, 2021) explained that the four most important steps in data management are: data collection, data process, data exchange, and data interoperability. Furthermore, data management must be done considering the European Union directive on data protection, called General Data Protection Regulation GDPR (Parliament, 2016).

4.2.1 Data Collection in Education

The main issue for high school services based on AI technologies is the lack of students' data. For this reason, data collection is a very important step in the development of this typology of services, to ensure sufficient quantity and quality of data to be able to train the technology. According to (Stina, et al., 2021), the AI models taken into consideration in the case study need three main domain data: personal information such as skills, competencies, goals, work history, and references; career information such as job advertisement, recruitment process information, labor market forecast, and labor statistics; education information such as degrees and qualification, study records and grades, current study rights, career monitoring survey, and theses. The critical point is to figure out where and how to get all this data. Open government data (OGD) is a very interesting source of data, especially after the rapid growth of research in this field, which has led to the continued evolution of technologies and management approaches for OGD (Charalabidis, et al., 2016). OGDs are characterized by three important factors: transparency, realizing social and commercial value, and participatory governance (Attard, et al., 2015). Transparency allows stakeholders to access, use, reuse, and distribute data, to create benefits for society (Dawes, et al., 2016), and to facilitate informed collaboration (Ruijer & Martinius, 2017). The government has the data of schools and the opportunity to use it for different purposes encourages stakeholders to innovate and create new services (Attard, et al., 2015). Research on OGD identified considerable technical and social barriers that stand in the way of achieving desired benefits (Dawes, et al., 2016). The barriers are categorized at the institutional level, the task complexity of handling the data, the use of open data and participation in the open-data process, legislation, information quality, and at the technical level (Janssen, et al.,

2012). These barriers affect both providers and users since data must be available and easy to access, and the user may be able to use and process data. Professionals are tasked with reducing barriers through the development of tools to support data search, analysis, visualization, interpretation, and interaction. Also, it is important to train potential users, especially people with a lack of digital skills (Zuiderwijk & de Reuver, 2021). The digitalization of international large-scale assessments through fully digitally based assessments, called DBAs, can be a source of students' information. Indeed, DBAs allow having better and easier data management, and access to students' data such as skills, background factors, demographic characteristics, learning contest, educational attainment, and educational skills (Kirsch & Braun, 2020). The outcomes of DBAs have proven to be highly satisfactory and consistent with the traditional way results, even if there are several constraints of technology accessibility for some areas (Bethany, et al., 2018). Another source of students' data can be the Career Adapt-Abilities Scale-Italian Form (CAAS). With the CAAS form, it is possible to collect students' information about career adaptability in the preadolescence phase (Di Maggio, et al., 2015). Furthermore, from the responses obtained from the students, ML models, such as cluster analysis or data mining, could be applied to obtain hidden feedback from the students and thus have more information (Anwar Muhammad, et al., 2015). Another very important resource for how the world is evolving is social media. Today's youth spend a lot of time in front of their smartphones, making them a very important source of data. (Yu, et al., 2013).

4.2.2 Data Process in Education

The Government Chief Data Officer of Estonia during a lecture on the "Information Society Principles: towards e-Governance" course (Velsberg, 2021) (Velsberg, 2021) said that data are assets, which must be managed as such to be able to create value from them. Once a large amount of qualitative data has been collected, it is necessary to run processes on it so that we can use it to build an AI model for high school seniors (Ives, 2021). The first thing to do is to organize the collected student data, labeling them and creating categories to distinguish their interests, attitudes, future expectations, and context where student lives (Santilli, et al., 2018). After the labeling process, the data must be used to train the predictive model, to obtain a good outcomes quality. This process is very time-consuming, and it takes more than two or three months to make sure you get a good quality predictive model. At the end of this phase, the AI technology model will be ready

to provide the results, which correspond to the probability that a student may be better suited for one path than another (Ives, 2021).

4.2.3 Data Exchange in Education

Data exchange means to ensure the access of data by stakeholders, but it is important to ensure its protection and a high standard of quality. First, it is important to be able to create a registry or database that supports a reference platform to facilitate access to education information. For example, the Estonian Education Information System (EHIS) is a database that stores all the information about the Estonian educational system (students, teachers, and institutions) (e-Estonia, 2020). EHIS makes easier the students' life facilitating the data exchange between different institutions. Instead, Italy offers an open data platform (Digitale, s.d.) where everyone can find different information about the Italian government, including those related to the educational system. Furthermore, the data governance structure within the organization plays a key role in this step. First, it is necessary to identify a data owner, on whom all responsibility for the data and the entire business falls; then, the roles of data stewards must assign, who are tasked with describing the data to ensure that its quality is high and that the data is shared among all stakeholders. (Velsberg, 2021)

4.2.4 Data Interoperability in Education

Data interoperability is an important feature and allows data to be shared between different organizational entities. Through data interoperability is possible to apply the master data management first principle, which ensures that the data is collected only once (Velsberg, 2021). By doing so, data collection becomes much more streamlined and faster, while also facilitating accessibility. To succeed in building efficient and secure data interoperability system, it is necessary to develop a good data infrastructure (Velsberg, 2021). For example, the Estonia government uses X-Road such as a data exchange layer. It is the backbone of the e-government and enables to exchange of data between the different organizations, also in a different field, securely and transparently. X-Road ensures that all data is signed by the data owner and encrypted, to ensure the privacy of its citizens and maintained data integrity (e-Estonia, 2016). The technology that can bring major changes to data interoperability is blockchain. Blockchain technology with its features of transparency and decentralization can facilitate communication between different educational institutions (Shen, 2021). School database

infrastructures are almost all exclusively accessed by school employees, with almost no interoperability. Blockchain technology would allow for easier exchange of information and more secure verification of certificates from their respective schools (Programme, 2020). The records are permanently stored on the distributed ledger, and no one can change such data published by educational institutions. Furthermore, a smart contract could be used to automize exchanges of information between two different entities upon the occurrence of certain conditions present within the smart contract (Programme, 2020).

4.3 GDPR in Education

Creating a digital service that needs students' data requires compliance with the GDPR's (Parliament, 2016) minors data protection rules, which have been in effect since 2016. Article number eight states that it is only lawful to offer services that process students' data if the minor is over 16 years old. Otherwise, if he or she is under the age of 16, authorization is required from the parents or who are still responsible for their children's data. Article number six states that fair processing occurs if the students' data is used to accomplish a service of public interest or related to the owner of the data being processed. The GDPR states that students need greater protection concerning their data, as they may be less aware of the risks, consequences, and rights to the processing of their data. This protection occurs in the case of the creation of personality or user profiles when using services provided directly to a child. But if the student's data is used for prevention or counseling services provided directly to the child, parental consent is not required.

4.4 Orientation Programs Theory

Orientation is recognized as a lifelong right throughout a person's life and is important to students during their post-high school transition. Indeed, guidance should help students in their final year of high school manage their entry into the world of work or continuation of their studies. The orientation programs aim to provide them with the information that students need to make a better decision about their future (MIUR, 2014). A theory concerning the choice of the high school students' careers is the Study Choice Task Inventory (Germeijs & Verschueren, 2006). This is a career decision-making process that includes different tasks such as orientation, exploration, and commitment. The Study Choice Task Inventory begins from a general orientation and exploration of the

environment. After this there is a broad exploration of the alternatives, to have a clearer idea about the other chances. The last step is an in-depth exploration of the reduced set of alternatives, to create a commitment with one or two of them (Germeijs & Verschueren, 2006). Guiding young students through this transition is also important because the newcomers to the labor market often take more time to find a suitable job than regular job seekers. This leads to an unfavorable condition towards young students approaching the world of work because they are more likely to experience a job mismatch and suffer from underemployment (Koen, et al., 2012). Furthermore, high school students' seniors need to enhance Career Decision-making Self-Efficacy (CDSE) during the transition post-high school. This allows them to reach better employment outcomes and sustainable career development, becoming more confident in making a career decision. Moreover, teachers and vocational educators can help to improve students' CDSE with training programs for proactive thinking and providing successful role models (Lu, et al., 2020).

4.5 Covid impact in Education

The pandemic has led to numerous changes around the world and in different fields, including the education sector. In fact, with the inability to run in-person classes, schools and teachers have had to adapt to remote classes. This has been possible thanks to the use of information and communication technologies, which have allowed professors to teach their students, obviously losing some interaction and contact with the students (Villegas-Ch, et al., 2020). In general, covid has facilitated the digitization of the education system, transforming classroom content into digital format, and facilitating the exchange of information through information and communication technologies. All of this makes it possible to integrate new technologies such as AI and data analysis into education, with which you can improve the learning management system. In this way it is possible to surrounded students with AI virtual systems, to guide them in their learning path (Villegas-Ch, et al., 2020). The main issue to implementing these guidance services for the students is inadequate access to information and communication technologies. Indeed, not all schools can afford highly digitized tools, and this creates inequality for accessibility. Furthermore, other issues are the availability of technological skills and competencies within the schools' personnel capable to integrate new technologies, and inadequate access to the students' information (Kettunen & Sampson, 2019).

5 Case Study Results: PEST and Interviews

The information provided in this chapter is the outcome from the two case study analysis methods used for this research: PEST analysis and interviews. PEST analysis gives a thorough overview of the current situation of the Italian educational system, with a focus on the transition post-high school. This analysis reviews some of the key aspects of the past, especially from an economic and political perspective, that have characterized the Italian youth crisis. The social part of the analysis provides insights to understand what Italian cultural aspects influence the decision-making process in the post-high school transition. From the technological point of view, it is important to understand how the technology level of the Italian education system is, to provide digital services that help seniors in their future decisions. The information of this analysis was found through secondary research conducted with online scientific articles providers, such us Tallinn University of Technology library or Google scholar. Instead, interviews were conducted involving all the various stakeholders involved in the decision-making process of post-high school transition. Interview questions for each stakeholder were found through two video calls conducted with the RoboRAVE founder (Appendix 2, Interview 23 and Interview 24). His experience in AI and education was critical to finding effective research questions. The purpose of the Italian university students' or alumni's interviews was to understand what the critical points of their post-high school transition were, what orientation activities led to making the choice, and what variables were considered in the decision. The interviews practically focused on students who changed or left the university (more than 90 percent of respondents). The Italian professors' interviews concerned three different roles within high schools: orientation program manager, PCTO manager, and teachers in the final years of high school. This research involved two orientation managers and a high school professor who covered this role until last year. The managers interviewed come from a scientific high school and a technical institute of Omegna, a small village in the province of Verbano-Cusio-Ossola (Italy), to have an analysis that includes different high schools. The interview questions (Appendix 4) are related to the organization of college and career guidance activities. These provided

insight into how contacts with universities and surrounding workplaces are managed and how it could be improved using AI. It was important to understand how and what students' data are used in the orientation program process and what digital tool the managers use to help them to perform this orientation program. Instead, PCTO manager is a role created recently chasing reform (Republic, 2018) in 2018, the year in which the project was made mandatory in all Italian high schools. In this research one PCTO manager and one high school professor who performed this role when the project called "*alternanza scuola-lavoro*" (Galli, 2012) are involved. The PCTO manager's interview questions concern the management of all the activities performed by this position and how this project is evaluated at the end of the students' work experience. Much of the interview focused on how the manager creates the match between students and jobs, understanding what students' characteristics are considered in this process. This is an important point in understanding how the implementation of AI-based services could help the PCTO manager to improve the realization of the PCTO project for each student. Two teachers in the final years of high school are involved in this qualitative analysis, one from a scientific high school and one from a technical institute. The interviews aim to understand the role of the teachers during the transition post-high school. How and if the teachers help seniors to decide their future path since they should know better than other people the students' aptitude and skills. (MIUR, 2014). An AI workshop was conducted at Tallinn University of Technology to have a better understanding of the potentiality and issues of AI implementation in this research. The AI workshop involved three researchers of the Estonian university that are specialized in AI technology. The workshop questions were formulated with the intent of creating a discussion that would provide useful information to answer the research questions.

5.1 PEST: Political

The Italian youth crisis is the result of certain policies that have been taken over the years, aimed at changing the Italian educational system. This progressive devaluation of the school system started in the sixties when two major organizational and accessibility decisions were made (Ricolfi, 2019). A policy from 1962 completely changed the organization of the post-elementary school. There were two different typologies of medium school before being divided between "vocational starter" and middle school. After the reform, a single middle school was adopted that do not offer a professional

course of study. A 1969 policy increased accessibility to universities, allowing anyone to enter universities without access restrictions. These policies are very important to give more equality and equal opportunities for all, but the other side of the coin is that university degrees have progressively lost importance over time (Ricolfi, 2019). Furthermore, increased university accessibility also led to an increase in the dropout rate after the first year of university and lengthening the time it takes to graduate. Most universities allow students to repeat exams as many times as they want, without having a cap on the number of university enrollments (Carrieri, et al., 2015). Increasing accessibility also decreases the quality of teaching, as placing admission policies in universities rises the quality of relationships between students and their performance (Carrieri, et al., 2015). Other policies aimed at improving the accessibility of universities were made in the early nineties. These reforms aimed to increase the territorial capillarity of universities, decreasing the direct and indirect cost of mobility for students (Bratti, et al., 2008). All these policies from the past foment the "parking lot" hypothesis, in which seniors high school students enroll university such as a default decision. Thus, the efficiency of the Italian educational system decreases, and the students have less desire and the incentives to achieve a better job (Bratti, et al., 2008). In recent years there has been a particular interest in orientation, not only at the Italian level but also at the European level. The strategy imposed by the European Commission is based on innovation, sustainability, and inclusiveness. It aims to increase the employment rate and integrate young people into society and the economic realities of the territory. The key concepts of this strategy are lifelong learning, life-wide learning, lifelong guidance, and career guidance (Commission, 2010). To meet the objectives imposed by the European Commission, the MIUR has promulgated two strategies. The first of these relates to orientation, in which it is no longer just a tool that is used to manage the transition between school, training, and work. The new definition of orientation is a permanent value in the life of each person, reiterating the concepts of lifelong learning and lifelong guidance (MIUR, 2014). From this strategy was born the PCTO project, which consists precisely in giving work orientation to high school students (MIUR, 2018). Indeed, the purpose of the PCTO project is to create connections with local realities and help young people to find their path based on their skills and expectations (MIUR, 2014). The other strategy promoted by MIUR concerns the theme of innovation through the "*Piano Nazionale Scuola Digitale*" (PNSD), translated into "national digital school plan" (MIUR, 2015). The PNSD is a document that outlines the digitization strategy for all Italian schools,

starting with elementary school. The objective is to improve the efficiency and the management of the school system, in terms of time and resources. The Italian government recognized the great value of the nation's education system's information assets, both in quantity and quality of data. The state established a single school data portal allowing easier access to school data, through a 2015 law (Republic, 2015). The open data of the new unique portal can be used by anyone to create new services that can improve the Italian school system.

5.2 PEST: Economic

"Education is the only sector of Italian society in which productivity has been steadily declining for more than half a century" (Ricolfi, 2019). The productivity of education means the inverse of the years it takes the school system to form a given level of mental organization in the youth of society. The average fifty years ago was about the end of first-grade secondary school, but now on average youth people reach a maturity of mental organization only eight years after the first-grade secondary school. This leads to a slower transition from school to the world of work as students do not have clear ideas about their future (Ricolfi, 2019). The inflation of educational qualifications also increases the difficulty of getting young people into the world of work. The job market requests increasingly higher degrees to do trades and professions. Thus, students must spend more years in education, so families must spend more money to ensure a future for their children (Ricolfi, 2019). Fortunately for Italian families, ease of access and increased ubiquity have lowered the cost of university studies. It leads to an increase in the number of graduates, creating a devaluation of degrees, and to an increase in university dropouts (Bratti, et al., 2008). The inflation of educational qualifications caused a mismatch between students' postgraduate expectations and the demands of the job world, leading to a new phenomenon: voluntary unemployment. The youth people are not willing to accept the conditions offered by the market, so they do not find a job because they are too choosy, causing repercussions to the Italian economy. This choice of voluntary unemployment is also caused by the high expected inheritance of young Italians, which is the highest in Europe. The expected inheritance depends on three factors: the degree of patrimonialisation of families, the weight of the elderly on the population and the weight of the young on the population. Italy is a very elderly country, with a low weight of young people in the population and is in fourth place as a level of capitalization (Ricolfi, 2019).

In Italy, the relationship between the variation of the unemployment rate and the variation of the GDP rate identified by Okun's law is respected. A positive variation of the unemployment rate determines a negative variation of the Italian GDP (Busetta & Corso, 2008). The condition to refuse easily a work is also due to a change in purchasing habits that have changed over time. Previous generations had a propensity to save by making few purchases and investing in capital goods. Instead, young people today have a low propensity to save and are changing the way they purchase, using the formulas of leasing, rental, and monthly payments for services (Ricolfi, 2019).

5.3 PEST: Social

The most important social factor for youth education is the role of the family, an aspect that is inherent in Italian culture (Ricolfi, 2019). Parental support during the study path of the students is positively correlated with career decision-making self-efficacy (Pianpian, et al., 2016). Parents' influence is more evident if they are higher educated and professionals and their kids tend statistically to take a path in the same educational field (Helland & Wiborg, 2019). Low parents' involvement is one of the most predictive factors of the high school dropout, along with other variables such as socioeconomic status, academic performance, and absenteeism (Parr & Bonitz, 2015). Furthermore, the socioeconomic status and the academic background of the families affect the students' transition post-high school. The students with a lower family's socioeconomic status need to be helped more than others, giving them more services and involving the family in the decision-making process (Lu, et al., 2020). Instead, the students with a non-academic family background need more information since they are underrepresented in universities and providing them more information could reduce the education inequality (Peter & Zambre, 2017). Another important social factor is the difference between the north and south of Italy. The transition to adulthood is characterized by different factors in the two distinct areas. Personal relationships are important in the south of Italy to reach a satisfactory level of life. Instead, psychological wellness and economic independence from the family give satisfaction in the students' choice of their path in the northern part of Italy (Piumatti, et al., 2014).

5.4 PEST: Technological

The innovation of the education system is one of the directive's objectives promoted by the European Commission (Commission, 2010). MIUR moved in this direction by publishing the PNSD, which contains all the strategies for the school system digitalization. Digital identity and digital resumes are very important tools that MIUR wants to implement to make it easier and safer to manage students and their learning. Furthermore, a digital resume becomes a tool to verify and evaluate the competencies that students learn during the academic path and in extracurricular activities (MIUR, 2015). MIUR invested a lot of effort to improve the management of the school through digitalization and to provide more digital services for the students and their families. The electronic register aims to make easier the school organization management, allowing more direct communication between schools, families, students, and professors. Innovation in educational institutions comes primarily from creating a computer system such that student data can be recorded. 94% of Italian schools have their own IT system suitable for record-keeping, but 68% do not have an active records management system, and about 80% do not have legal electronic storage (MIUR, 2015). Also, the development of the OGD platform of Italian schools, allowed the educational system to improve the monitoring of institutions and allows stakeholders to produce new digital services (Republic, 2015). The main problem of the Italian OGD is the task complexity of handling the data, involving citizens' collaboration and participation, and spurring innovation (Saxena, 2018). This caused limited evidence of OGD's potential transformative value, due to scarce data use. It particularly depends on the lack of technical skills and user training on OGD (Gascó-Hernándeza, et al., 2018). Monithon, or "monitoring marathon" of public spending, is an initiative to solve the social issue and engage local groups in verifying how funds from European Union are spent in Italy. The people involved can find the information about these projects on the national webpage OpenCoesione.gov.it (coesione, 2020), to improve the policy effectiveness (Gascó-Hernándeza, et al., 2018). The covid pandemic has certainly negatively affected the quality of teaching, but at the same time, it has introduced the use of information and communication technology in the school system. This is certainly a step forward from an innovative point of view, which could be decisive if accompanied by using new technologies (Villegas-Ch, et al., 2020). Analyzing the technology chosen in the case study, AI emerges as one of the most important technologies to improve global education (Sun, 2021). Furthermore, AI and

ML implementation trends for decision-makers concern the improvement of the customer experience and generating customer insights (Worldwide & Algorithmia, 2022). Investments made in AI are also rising sharply. From 2015 to 2020, investments in this technology have increased more than 400%, reaching an amount of about sixty-eight billion dollars (Worldwide, et al., 2021).

5.5 Interview Results

The results of the interviews are found only after the transcription and translation from Italian into English. The first analysis activity performed is coding, in which labels are identified to recognize what stakeholders expressed. Once all interviews were coded, categories were identified for each stakeholder type through propositional statements that defined them. Starting with university students or alumni or high school students, eight categories were found with their relative propositional statements. The environment category refers to the sentences about the changes in lifestyle, city, and university environment. The work experience category concerns all the students' work experience done during their academic path and how these experiences improved their awareness about their future path. The orientation category alludes to the student's opinions about the efficiency and inefficiency of orientation programs. The orientation activity includes all the activities that students did in their transition post-high school. The decision-making variable concerns all the factors that influenced students' decisions about their academic path or work path. The information category refers to the fact that students have or do not have enough information when they made the decision. The interest development category concerns the different ways students used to develop an interest or passion. The PCTO category includes all the students' opinions about their project's experiences, distinguishing who did the project and who did not do that. The feelings category describes the emotions and feelings expressed in the interviews. The major concepts that emerged from the students' interviews are experience, information, and PCTO (Figure 1). Regarding the interviews of professors, it is necessary to distinguish three different figures: the professors who are involved in orientation activities and the PCTO project as tutors; the orientation program manager who organizes university and work orientation activities; the PCTO manager who manages and organizes all the activities and stakeholders related to the project. Three categories were found for professors involved in orientation activities and PCTO projects: PCTO tutor, orientation activity, and

students' data. The PCTO tutor category concerns the role of the teacher such as students' tutor during the PCTO project. The orientation activity category regards the professors and the orientation program manager, and it refers to the activities in which professors are involved and how they are involved in these activities. The students' data category involves all the three stakeholders and concerns how the students' data are stored in the school system. Three categories were found for the orientation program manager: orientation activity (previously discussed), orientation variable, and orientation process. The orientation variable category refers to all the factors that the orientation program manager uses to organize the orientation activities. The orientation process concerns all the tasks that the orientation program manager must perform during his or her work. Other three categories were found for the PCTO manager: PCTO process, PCTO variable, and PCTO data. The PCTO process category refers to all the tasks that the PCTO manager must do in his or her job. The PCTO variable category concerns all the students' factors used to create the match between job and student. The PCTO data category is about how the data about students' PCTO projects are stored in the school system. The major concepts that emerged from professors' interviews are orientation, PCTO, and students' data (Figure 2). The following sub-chapters show the results obtained from the qualitative analysis of the interviews, dividing them by each stakeholder.

5.5.1 Interview Results: Students and Alumni

University students and alumni showed a particular interest in the university environment. More than 50% of the respondents mentioned the university environment, the cost of city life, and 27% of these students showed that they did not meet their initial expectations about the university environment. Economic independence from the family is one of the biggest reasons 60% of respondents decided to go to work. The general opinion about the work experiences is that they give more awareness about the job world and what students should do after high school. Regarding their experiences with the PCTO project, half of the respondents whom did this experience show an overall negative evaluation, even though it has raised their awareness. They find PCTO useless for a lack of responsibility, less correlation with the learning agreement of the high school, bad organization of the projects, and lack of information and clarity about the task at hand. Interviews conducted with youth from diverse high school backgrounds revealed general heterogeneity in the organization of work activities. This is evidenced both from the perspective of different high schools, but also geographically. Students who studied in the cities showed a positive

evaluation of the project because of the many opportunities for work experience that the large metropolis can offer. Furthermore, each high school implements different strategies, based on own resources and typology of high school, underlined a lack of standardization of the PCTO procedure. The awareness that these experiences give students must be accompanied by orientation activities, which provide important information for making the post-high school decision. The general opinion about the university and job orientation is the lack of information, 80% of students interviewed didn't have enough information to decide. This affects several areas such as university life, changes in the study methodology, university courses, and future jobs. Students mentioned that they often have information only about the best reputation universities, which does not allow to have a general overview. Instead, youth from the cities showed a state of confusion due to the presence of so many universities and opportunities. The orientation activity most frequently mentioned in the interviews is the university open days, although opinions are not very positive. 37% of students found this activity not helpful because of the way it was presented and because of a geographic issue. These universities' open days were always done in attendance at universities before covid, which disadvantages those who live far from the locations. Another activity that 60% of respondents have performed but did not find useful is student fairs. In this activity, high schools set up stands to present different universities on an orientation day. The most useful sources of information are the opinions of college students, who provide useful information to high school students, knowing their views well. Internet and social media are also popular ways for students to find information. Students highlighted the opportunity to be able to take mock tests, which gives them much more awareness of their abilities. These mock tests are used to help high school students prepare for college admissions tests, which often turn out to be a blocker. The admissions test turns out to be a decision variable for students, who then choose universities where there is no admissions test to avoid the anxiety of not passing the test. In addition to this variable, the other most important decision-making variables are interests/passions, family influence, and professors. 80% of the respondents chose university through a decision guided by their passions and interests. Asking students how they have cultivated and developed their interests, two paths emerged: the more modern path based on movies and video games; a more traditional path based on activities done as a child or from studies learned in school. Families turn out to be a very significant decision-making variable. 50% of the respondents showed that families influenced their post-high school decision, and this is more evident if the family has a university

background. Professors are considered also very important figures in this decision-making process as they should know more about students' abilities and aptitudes than others. However, 80% of students interviewed showed disappointment about lack of help from high school and more than 30% highlighted professors suggested avoiding some university courses. The emotions shown from the respondents during the interviews are a sense of abandonment, loneliness, and insecurity. These feelings are also prompted by the short window of time in which young people receive information about universities. The high school student interviewed mentioned that no university orientation activities had been done yet in early January.

5.5.2 Interview Results: Professors

The role of high school professors in students' decision-making process for post-high school is crucial. The teachers interviewed showed great interest in the orientation of their students, reiterating their active role in this process. 75% of professors said they make suggestions to students and help them to find information about the various universities they are interested in. In this task is essential that teachers make some advice objectively, without placing barriers or not doing a particular university. However, the students' interviews revealed that professors prohibit students from taking a path. A teacher mentioned the importance of teaching students metacognition, getting them to reason about their aptitudes, abilities, passions, and interests, to help them find their path. To carry out a good orientation program, it is very important to establish the cooperation of all high school professors. However, the teachers interviewed stated the great difficulty of creating a cooperative working environment for several reasons. A certain number of high schools professors change every year, and this makes more difficult the professors' management. Furthermore, many professors are not in favor of working more hours to do orientation for kids as they feel these activities are not part of their job description.

5.5.3 Interview Results: PCTO Manager and Tutor

The role of the PCTO manager was born with the creation of the PCTO project to manage all the activities in the best way to obtain a good result. His or her tasks aim to coordinate all the project activities such as students' safety, create the match student-job, coordinate tutors, make sure that logbook is filled correctly, collect data, maintain high quality, and evaluate projects. The interviews highlighted how this work requires a lot of effort and is very time-consuming. PCTO manager interviewed managed all the projects of a high

school with three different addresses: scientific, artistic, and musical high school. The manager pointed out that the project management process needs to be handled differently for each address. Indeed, PCTO managers must find jobs that are coherent with the learning agreement of the high schools. This task is easier for specific studies such as musical and artistic, but it is very difficult for general studies such as scientific ones. The manager stated that it is more likely for science students to have bad experiences. The experiences result depends also on the location of the high school since in bigger cities there are more opportunities than in small villages. Proximity is one of the main factors that PCTO manager uses to create the match between students and jobs, to allocate them near their residence for a question of transportation costs and a question of accessibility. The other factors used for this process are the coherence with high school learning, students' interests, and sometimes students' performance. Students' performance is considered only for special jobs, which required a higher level of education. Students' interests are often considered during the matching process between students and jobs to satisfy their requests. PCTO manager asks directly to students their interests through a personal interview with all the students, also online after covid, or through a survey that makes it easier to analyze and collect. Furthermore, students can propose some projects to do if they know a company where they can go. Also, certificates of language and online courses could be recognized as PCTO projects, but the school must decide. This situation shows that there is no standardization in the PCTO process, and it could change for each high school. PCTO manager mentioned the importance to develop a database of area companies during the years. This task is very long and laborious and to do this the PCTO manager must have good knowledge and a good connection with the economic reality of the area. PCTO manager mentioned two other main problems: the short duration of the experiences and many paper-based documents for the project. The short duration of the project leads to a lack of employer incentive to devote more effort to teaching the craft to students. Instead, the student fails to develop new skills as this requires more practice. A huge number of paper-based documents is linked to requests for signatures from project tutors. Although, the electronic register is trying to make the exchange of information and documents more digital and leaner.

5.5.4 Interviews Results: Orientation Program Manager

Orientation programs have been severely impacted by the pandemic. Before the pandemic, orientation activities took place physically and in person, but later it changed

modes by providing information through virtual classrooms, email, and electronic register. This slow digitization of processes has had a positive impact on the orientation program manager since it allows to manage the orientation activities in a better and in a simple way. In particular, the monitoring and collection of data related to orientation have improved dramatically. The orientation program manager needs to collect post-high school preference data that students have at the beginning and during their senior year of high school. This data will then be compared to the final choices students have made. Before the pandemic, this was done through a personal interview or an email question that students had to answer. Quite often students did not respond or they responded less than fully, making it very complicated to monitor the quality of the orientation. The use of new tools like google forms has helped the orientation program manager have data that is easier to read, monitor, and compare. These data are stored in the high school database, but it is not a standard and it depends on the high school informatics technology infrastructure. The orientation program manager also asks students' interests, to organize orientation activities that can satisfy their request. This information is not stored in the high school database, and they are used only for the organization of orientation activities and connecting students with professors who are experts in their interests. Before the pandemic, the orientation program manager collected this information through personal interviews or by asking to write a list of students' interests. With remote learning, the manager has adopted new techniques, asking for this information through forms. Interviews conducted revealed that the most important university orientation activity is open days. Open days are the preferred tools of universities to be able to give information to high school students. Pandemic has also facilitated the accessibility of these activities as they now occur online through webinars or virtual classrooms. The orientation program manager also mentioned the student fairs, in which more universities together are presented to the high school students, but this activity could not be repurposed after the pandemic. The manager focused on the importance of building relationships with universities to connect high school students with them. In addition to open days, other activities are organized in collaboration with universities such as workshops and mock tests. The orientation program manager also mentioned job orientation activities such as job shadow and meeting with local professionals. These activities are useful in providing the student with information about the job world and giving them greater awareness of their potential jobs in the area.

5.5.5 Interview Results: Students Data Management

The two high school institutes involved in the case study research showed a huge difference in how they handle students' data. High schools can use the electronic register to record the students' performance and easily communicate with students' families. Some high schools have their database to store information about orientation and PCTO. However, this does not happen in all high schools because each school decides independently whether to create a database. The two high schools involved showed this difference since one is more paper-based storage than the other one. This underlines the lack of standardization of IT infrastructure within the Italian high schools. PCTO manager mentioned that orientation and PCTO projects do not exchange information, causing duplication of student data. Students' data are principally collected for internal use and only a few of them are shared with the MIUR. With the creation of the PCTO project, progress has been made from a student data tracking perspective. The student's portfolio created with the PCTO project allowed for tracking of the PCTO experiences and other extracurricular hands-on experiences the student had. It is a sort of students' curriculum vitae in which is reported all the personal experiences, certifications, projects, and workshops. Some schools may integrate to the student's portfolio, the activities carried out during the PCTO project. However, this is only possible if the school has an electronic register with a logbook of the students. One of the two high schools involved in the research did not have this digital tool and still uses paper documents. Remote learning has allowed the high school and the professor to use new digital tools to teach, through which student information can be collected.

5.6 AI Workshop Result

The opinions from the AI experts of Tallinn University of Technology allowed the researcher to understand the main issues and feasibility of AI-based services implementation to improve the post-high school transition. The most critical factor inferred from the AI workshop is the availability of a huge number of qualitative data. The feasibility of AI implementation depends on it and if it is possible to collect data about the students' interests, willingness to study, extra-school activities, competence, and passions. The information from the job market is very important, to understand the trends and the job market requests that can be useful for the future of high school students. The experts said having multiple sources of information that provide more data is critical

to making the predictive model more efficient. This could allow you to be able to best train and develop intelligence to make suggestions to high school seniors. First, it is very important to understand which kind of data is needed by AI technology to make some recommendations to the students. This information can be gathered from the analysis of the primary research, to find which factors affect the final decision of the students in their post-high school transition. Primary research can be conducted through either interviews or a questionnaire. The latter is very useful as it is more scalable and can better quantify data through scales, such as the Likert scale. Furthermore, the questionnaire is easier to spread and to reach more people, to get more data. The digitalization of the students' data collected is fundamental for the implementation of AI-based services. The data digitalization could allow to create standardization in the data collection that can improve the effectiveness of the model. The experts said that AI-based services could improve the orientation activities, providing students with recommendations about jobs and universities, based on their interests and passions. According to expert opinions, AI-based services should provide at least 4/5 recommendations with an explanation. In this way, students would be able to get a more concrete idea of the opportunities that lie ahead for their future.

6 Discussion

This chapter aims to answer the research questions and to check if the related hypothesizes of the questions are verified. The results described in the previous chapter are compared with the information reported in the theoretical overview, to analyze the feasibility of the AI-based services implementation to help Italian high school seniors. The hypothesis that concerns the current Italian context is prone to the introduction of AI in the educational system turns out to be false. However, some factors are favorable to the adoption of AI technology. From a policy perspective, the positive trend in life path orientation policies is an incentive to seek new solutions to solve the crisis of Italian youth people (Commission, 2010). The publication of the PNSD aims to digitize Italy more through different aspects, encouraging the implementation of new technologies such as AI. The expansion of internet access throughout the country and the creation of a student digital identity are two important goals of Italy's digitization plan (MIUR, 2015). These two innovations would make it possible to leverage the extraordinary information assets of the Italian education system to create digital services that help students. From the technological side, AI technology turns out to be one of the technologies with the highest investments (Worldwide & Algorithmia, 2022). The pandemic has increased the trend of implementing AI-based services and the digitization of the school system. The primary research showed how the orientation program manager had to adapt activities and management to the pandemic crisis through digital communication tools and a new way of providing information. The critical factors of the current Italian situation that do not allow the implementation of AI-based services emerged from the interviews. Students and professors showed several differences in the post-high school transition, highlighting a lack of standardization in this process. This feature makes difficult the phases of data collection and data process, which are fundamental for the development of AI-based services (Velsberg, 2021). The data management differences between different high schools are the main problems of the data collection and data process. The two high schools involved in the research confirmed this critical factor, highlighting two different data management methodologies. One is much more digitized, with the use of its database

and monitoring tools. The other is much more traditional, with much data still collected in paper format. This does not allow to have a standard source of students' information and complicates the first phase of data collection. Furthermore, the interviews showed important geography differences both between high schools in the north and south of Italy and between those in big cities and small towns. Territorial inequality creates disparities in opportunities that complicate the data process phase. The development of AI-based services is very time-consuming and needs a large amount of qualitative data, so these differences increase the costs of AI training (Ives, 2021).

The work done during the research highlighted the falsity of the second hypothesis. The data infrastructure of the Italian school system does not allow the implementation of AI-based services. In recent years, digital tools have been provided to allow high schools to digitize and better manage their students' data (MIUR, 2015). Data digitalization is one of the critical factors that AI experts mentioned during the workshop, to create an efficient model. The electronic register is adopted from every high school, and it improved the data exchange between students, their families, and high school. The AI experts in the workshop suggested using questionnaires as possible sources to obtain useful information for AI-based services. The questionnaires turn out to be scalable and able to collect a lot of data that are crucial for the training and development phases of AI. AI experts mentioned the importance to collect job market information, to meet the needs of market demand, confirming the theoretical overview (Stina, et al., 2021). Other digitalized tools are not used by every high school, increasing the lack of standardization and the differences in data management. In particular, the electronic portfolio for the PCTO project is important for students' data collection. It allows gathering information such as soft skills, interests, and external activities, which are important for the development of AI-based services for the post-high school transition (Kirsch & Braun, 2020). The Italian OGD portal is a relevant data collection source but often the quality of the data is less than AI technology needs (Zuiderwijk & de Reuver, 2021). Research performed on the portal found that schools do not always upload all their institution and student data. This creates a clear discrepancy in the data process phase between different high schools. The data management heterogeneity emphasizes that the need to standardize turns out to be a fundamental prerogative to make innovations in the Italian educational system. The interviews revealed that much of the data collected by high schools remain within the institution, reducing the possibility of data exchange and interoperability (Programme, 2020). The orientation program and the PCTO managers showed from the interviews that

there is no communication between the two functions of the same high school. This causes duplication of data requested from students which goes against one of the data governance principles (Velsberg, 2021). To solve this problem, the use of blockchain technology could be useful. It assures data security and easier data exchange and interoperability, through the feature of transparency (Shen, 2021). Blockchain technology could also solve the problem of university switching, noted in students' interviews. The issue primarily concerns the possibility of transferring ECTS credits between universities. The student often must act as an intermediary between the secretariats of the two different institutions to get some of the past exams recognized. Blockchain technology would allow this process to be automated by programming smart contracts with agreements between universities (Programme, 2020).

The third and the last hypothesis is respected based on what was found by the research, so AI technology can enhance and facilitate the process of orientation programs and the PCTO project. The implementation of AI technology could help PCTO and orientation program managers during the data analysis processes and the related activities. The data analysis process could be improved through pattern identification and easier data visualization. AI-based services could provide useful supporting tools to enhance the activities related to the PCTO project and orientation programs, thanks to data about students' passions, interests, and attitudes. In particular, the PCTO manager highlighted from the interview a high number of tasks to be performed, stating that they are very time-consuming. In addition to monitoring, control, and evaluation duties, the PCTO manager is responsible for finding a company for each student, based on companies' availability and student interests. Considering that this task must be done for one hundred or so students each year, without any support tools the manager may be inclined not to look for the optimal solution for the student. The AI technology could make easier the process for matching students and companies, through the students' information and the job market information. The process of gathering student interests is also performed by the orientation program manager, who must find universities that meet student requirements. The two information collection processes are performed separately from each other, creating the problem of dual data collection. This goes against one of the principles of data management that previews the single collection of the same information to render the system leaner through the process of data exchange (Velsberg, 2021). Furthermore, AI-based services could use the data reported in the orientation portal of MIUR (MIUR,

2021), which turns out to be completely overlooked by students during their post-high school transition.

6.1 Limitation

The Italian youth crisis is a relevant problem that must be solved, to give the next generation a rosy and better future. This case study includes several stakeholders such as university students, high school students, students' parents, high school professors, universities, the job market, AI technology experts, and MIUR. The researcher tried to involve all these stakeholders in the interview (Appendix 2), but unfortunately, it was not possible due to time constraints and accessibility to some of them. AI technology experts were also willing to participate in the research, thanks to the network of Tallinn University of Technology and Robotex international exhibition. Professors, the PCTO manager, and the orientation program manager interviewed are part of the school staff of two high schools belonging to the territory of Verbano-Cusio-Ossola (Italy). University students and alumni were the most willing to be interviewed, talking about their experience during the post-high school transition. Most of the students interviewed come from northwest Italy, including students from both large cities such as Milan and Turin, and small towns such as the Verbano-Cusio-Ossola (Italy). The main risk of the analysis conducted in this case study is the possible bias due to the restricted area of the interviews. This bias could compromise the goodness of the work done, but unfortunately the resources and time available did not allow the researcher to have a representative sample. The geographic constrain is also a downside for the study of the phenomenon since the huge differences within the Italian boots. It was not possible to verify the differences between the northern and southern parts due to missing information sources from the south of Italy. The failure to engage other stakeholders such as students' parents, Italian universities, and MIUR may have caused an important lack of information for the research. The involvement of MIUR and Italian universities has proven to be very difficult from a timing and a communication point of view. Emails sent directly to the relevant institutions never received a response. Instead, those emails sent directly to people who were involved within different Italian ministries received late responses and without relevant information. Regarding students' parents, it proved impossible to find them through the researcher's network. Furthermore, psychological expertise or expert opinion would be required to study the parents' role in the post-high school transition. Their involvement

could also be relevant in analyzing interviews to find the best way for AI-based services to nudge students toward the best path for them.

7 Conclusion

The university and job orientation are beginning to be important in all Europe after the policies by European Commission. Italy in recent years has been looking for new projects to improve student awareness in their post-high school years, such as with the PCTO project. The new orientation projects have low technology and digital services content that could be used to improve related activities. Furthermore, there is an academic gap regarding how the implementation of AI-based services could help high school seniors in their post-high school transition. This case study research shows the potential of using artificial intelligence in career guidance and in university orientation, to solve the youth people crisis in Italy. Answering the first research question (RQ1), it was possible to understand that the current Italian context is not ready enough to implement AI-based services in the high school system. The PEST analysis allowed the researcher to have an in-deep analysis of the political, economic, social, and technological aspects of Italy. The policies done in the past about the inclusivity and open access to university caused the university choice such as a default decision. In this way, high school students' choice is done without thinking about the real reasons and purposes for the choice. Although the policies of recent years are in line with the improvement of orientation services, the digitization of the country is not up to innovation. The OGD portal and all the new digital tools are a step forward, but this has created a digital difference among high schools. Some of them are at a good technological level but others are anchored to a system based on paper documents and archives. From an economic perspective, this has led to an increase in educational qualifications inflation that has caused false future expectations for both students and their parents. Student data management is not enough advanced to improve the educational system through the new technologies (RQ2). From the interview of professors, PCTO manager, and orientation manager emerged the inefficiency of the data exchange and interoperability. Furthermore, the heterogeneity of high schools' digitization and data storage does not allow the implementation of AI-based services in the educational system on a national level. This is a missed opportunity as they could improve PCTO and orientation project processes (RQ3). Supporting tools could improve

the quality of orientation activities and PCTO projects. Relieving managers of time-consuming and laborious work so they can focus on optimizing the outcomes. Especially for the PCTO project, given the negative comments recorded during student interviews. Indeed, students often complained that they had negative experiences that were not very inherent to their course of study. Although, most recognized the educational value of the experience. Research findings indicate that AI technology can help high school seniors during their post-high school transition (main research question). The use of this technology could provide information and suggestions of the future path to pursue, based on students' interests, passions, and aptitudes. This could also lead to a different emotional state of high school seniors, who from the interviews showed a sense of abandonment, loneliness, and insecurity. The hope is that this solution and technological innovation of the educational system can give a brighter future to Italy.

7.1 Prospects of the Future Work

One of the future goals of the future is to reduce the limitations found during this case study research. It is crucial to involve all the stakeholders from different parts of Italy, to have a representative sample, given the great difference between northern and southern Italy. Using questionnaires could be a solution to be able to reach more people and have standardized data that is easier to analyze. This would make it easier for the researcher to look for the variables that most affect student decision-making. The heterogeneity of the data infrastructure does not allow the implementation of AI technology to a national level. But it could be possible to create a pilot project that involved those high schools that have some digital prerequisites. Indeed, the high schools that have an internal database, the electronic register, and digital tools to manage and monitor the PCTO project have everything they need to take part in a test. Through this AI pilot, it will be possible to see if indeed this can help reduce the percentage of NEETs among youth. If the percentage of NEETs were to decrease there would be both a positive effect on social welfare and an increase in GDP, according to Okun's law. AI pilot allows to have the funds to digitize high schools and to be a marketing tool for the innovative future of the Italian education system.

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Appendix 2 – Interviews

Interview 1 – University student 1, changed university

Interview 2 – University alumnus 2, changed university

Interview 3 – University student 3, changed university

Interview 4 – University student 4, changed university

Interview 5 – University student 5, changed university

Interview 6 – University alumna 6, changed university

Interview 7 – University student 7, changed university

Interview 8 – University alumnus 8, dropout university

Interview 9 – University student 9, changed university

Interview 10 – University student 10, right path decision

Interview 11 – University student 11, changed university

Interview 12 – University student 12, changed university

Interview 13 – University student 13, changed university

Interview 14 – University student 14, changed university

Interview 15 – University alumna 15, right path decision

Interview 16 – High school professor 1, Orientation director for technical subjects and tutor for PCTO project

Interview 17 – High school professor 2, orientation program manager

Interview 18 – High school professor 3, experience in orientation and PCTO management

Interview 19 – High school professor 4, PCTO tutor

Interview 20 – High school professor 5, ex orientation program manager

Interview 21 – High school professor 6, PCTO manager

Interview 22 – High school student, technical institute

Interview 23 – RoboRAVE, questions discussion round 1

Interview 24 – RoboRAVE, questions discussion round 2

Interview 25 – AI workshop with AI researcher from Tallinn University of Technology

Appendix 3 – Interview questions: students

1. Let's start to tell me a little bit about your post high school experience in general.
2. What university orientation activity did you do?
3. How did you choose the university? Did you choose it for your passion?
4. How did you develop this passion? What activities did you make to develop this passion?
5. What data did you have about your passion and the university? Do you think that this data was enough to decide?
6. Who is the person who helped you understand your abilities? / Who do you think might have been the best person to help you understand your abilities?

The researcher asked other questions if the students interviewed did the PCTO project.

1. Did you do the PCTO project?
2. What is your opinion about this project?
3. How did you choose your work?
4. Did anyone ask you about your interests in choosing the job?

5. Do you think that you apply what you studied in high school?

Appendix 4 – Interview questions: professor

Professor involved in orientation program.

1. Are you involved in the university or career orientation of the students?
2. What activities could the students do for their university or career orientation?
3. Does high school contact universities for the orientation?
4. How does high school choose the universities to contact?
5. If you have a student that is very good in your subject, would you suggest continuing the studies in your subject?
6. Do you know which project the student did in his high school years?
7. Do you use the electronic ledger to record the students' data? Do you also use another platform?

Professor involved in PCTO project.

1. Are you involved in PCTO project?
2. What tasks do you have in this project?
3. What is your opinion about this?
4. Do you also use another platform?
5. Do you know which project the student did in his high school years?
6. Do you use the electronic ledger to record the students' data? Do you also use another platform?

Professor is PCTO manager.

1. How can you choose the match between students and companies?
2. Do you contact each company in based of the request of the student?
3. Do you adapt the companies to the student?
4. What is the most difficult task to do in this project in your role?
5. How can you manage all the information from the PCTO project?
6. What is your opinion about your role in the project?
7. Do you think that it could be improved?

Appendix 5 – List of participants

1. RoboRAVE
2. *Liceo Scientifico Piero Gobetti di Omegna*
3. AI researcher from Tallinn University of Technology

Appendix 6 – Mindmap of Interviews Outcome

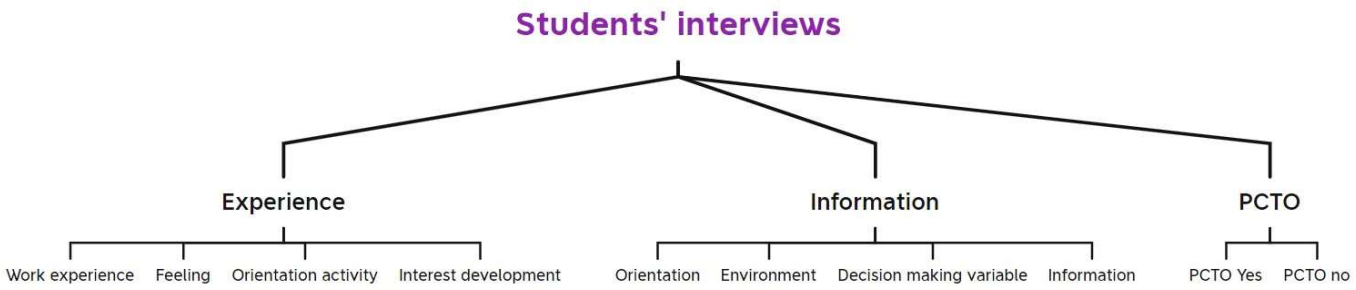

Figure 1. Key concepts from students' interviews

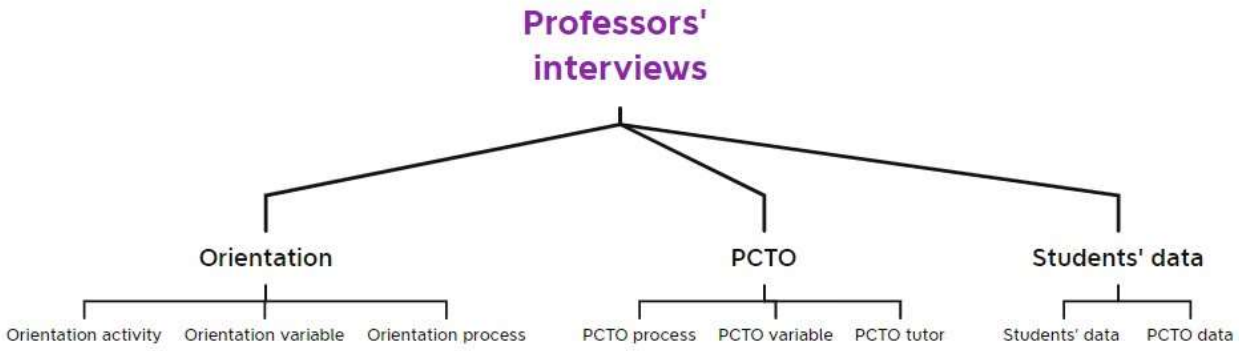

Figure 2. Key concepts from professors' interviews