

An intelligent platform for guiding future students to optimal university programs

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Abstract: *The analysis of university dropout at a systemic level is a relevant indicator for the efficiency of the higher education system. Combating dropout in technical higher education is of major importance for developing a skilled workforce and meeting labour market demands. As a result, high school graduates must be properly oriented towards technical study programs to contribute to increasing the country's economic competitiveness and stimulating innovation in different sectors. This paper, based on previous research has the aim to analyze the needs of high school graduates and to propose an interactive platform structure with a significant added value that will support the orientation process of high school graduates and will facilitate informed decisions regarding the choice of university study programs.*

Keywords: student's dropout, higher education, web platform.

1. Introduction

Young people who choose engineering fields often drop out of college in their first year. This is what the Report on the state of Romanian higher education 2021/2022 of the Ministry of Education shows. The document also notes that the passing rate of undergraduate university education, in the year 2021-2022, was 87%, according to the Report. The same source notes that the share of cases of repetition and unfinished school situation decreased by 3.6%, simultaneously with the increase of school dropout by almost 10%.

According to the same source, in the academic year 2020/2021, out of the total of 418,300 students enrolled in undergraduate education at the beginning of the year, at the end of the year there were 379,100 students.

A 2021 report by Babeș-Bolyai University in Cluj-Napoca points out that, at the undergraduate level, the dropout rate in the first year of studies has the highest values. "Of the total number of students who dropped out during their years of study, over 75% dropped out in the first year, in the case of 3-year programs, and over 40% in the case of 4-year programs," the report of the largest university in the

country. The lowest dropout rate is recorded in Timișoara, at 39.89%. In contrast, in smaller university centers hosting comprehensive universities with technical faculties, we observe higher dropout rates. For instance, in Hunedoara the dropout rate is 64.71%, in Prahova 58.18%, and in Dâmbovița 57.30% (Alexe-Coteț et al., 2022).

From a scientific point of view, the problem of dropout in technical higher education is a research topic of major interest. Recent studies have highlighted high dropout rates, with negative consequences for students' personal development, academic performance, and the economic and social needs of society.

Even though this topic is one of major interest, there is limited research on the theme of abandonment in higher education. Until recently, the data needed to develop a cohort analysis was lacking at the national level. There are many reasons why first year student's dropout from universities. If guided properly and supported by the academia environment, the abandonment rates may decrease.

The main objective of this research consists of an optimal targeting of high school graduates to technical university study programs to decrease the dropout rate from the first two years of faculty. In this article, a conceptual model of the interactive digital platform is proposed to provide detailed information about study programs and career prospects in the technical field, to support the orientation process of high school graduates.

From a technological perspective, the development of an interactive digital platform that provides detailed information about study programs and career prospects in the technical field may represent an innovative approach to support the orientation process and facilitate informed decision-making by graduates.

From a socio-economic perspective, combating dropout in technical higher education is of major importance for the development of a qualified workforce and for meeting the demands of the labour market. High school graduates properly oriented to technical study programs can help increase the country's economic competitiveness and stimulate innovation in various sectors.

2. Methodology

Through qualitative research are presented the main scientific studies towards students' dropout of universities. This issue is not a new one, therefore the authors have selected published articles from scientific databases from 2013 until 2024. The studies offer an overview of this topic at a global level.

To better guide future students in making an informed choice that meets their interests it is proposed a conceptual model for a web platform, that would support them through the entire process of choosing a bachelor program.

A focus group study was carried out at the university that engaged academic members from the management team, first year students as well as IT developers.

The subject was debated openly, and the results analysed and presented in Table 1.

The platform based on the conceptual model aims to decrease the dropout rates by offering choices that match their knowledge, abilities, and subjects to be studied. To design the conceptual model there were drawn requirements for both future students as well as for the university (Table 1). Future students may choose a program based on their interests and talents using the application's personalised features. It also offers guidance during the application process and comprehensive program information. It provides the institution with strong capabilities for tracking applications, evaluating future students' patterns, and keeping program materials current, all of which contribute to a smooth and efficient enrolment process.

Table 1. Requirements for conceptual model of the Web platform

Requirement	Details
User authentication	Login and sign-up functionality with secure password management.
User profile management	Ability for students to update their personal information, interests, and educational background.
Questionnaire tool	A guided assessment to gather data on student interests, strengths, and preferred subjects.
Algorithm for program matching	Logic to match student profiles with appropriate bachelor programs based on assessment results.
Program suggestions	Display a list of recommended programs based on assessment results.
Program information	Include descriptions, key subjects, potential career paths, and alumni testimonials.
Interactive curriculum map	A visual map of subjects and skills covered in each program, with clickable elements for more details
Comparison tool	A feature to compare multiple programs side by side on various criteria (content, job placement rates, etc.).
Engagement and support	Forum to connect and discuss programs, possibly moderated by current students or alumni.
Administrator Dashboard	A comprehensive view of the number of applications received, broken down by program and other relevant criteria. Visualization of trends in student preferences, such as the popularity of specific programs or subjects. Ability to assign different roles to staff members with specific permissions (e.g., read-only, full access).
Detailed applicant profiles	Detailed view of each applicant's profile, including their interest and skill assessment results.
Integrated email	Ability to send personalized emails to applicants

Requirement	Details
system	directly from the dashboard.
Program and curriculum management	A user-friendly interface for updating program details, course descriptions, and other relevant information.
Statistics board	Graphs and charts displaying the popularity of subjects, programs, and trends over time. Insights into the demographics of applicants, including geographic location, gender, prior education, and other relevant metrics.
Security	Implementation of data encryption, secure access controls, and compliance with data protection regulations (e.g., GDPR).

As stated previously, this is a conceptual model. When the platform will be developed, validation tests will be provided by pupils from 2 high schools in Bucharest, that have a mathematics-informatics profile. The platform will be presented to them by the management team of National University of Science and Technology Politehnica Bucharest, and feedback will be collected and used for adjustments of the platform, if case needed.

3. Current research on student dropouts

Dropout in universities is an important problem. More than a quarter of students admitted to bachelor's and master's study programs do not complete their studies.

Particularly in South Africa, higher education institutions (HEIs) have seen a high undergraduate program dropout rate. The literature currently in publication suggests that most students drop out for financial and personal reasons, which explains why the dropout rate is so high. According to research from throughout the world, the conversation surrounding students' experiences in higher education is where student dropouts are found. To investigate the problems that researchers must conceptualise while studying student dropout, this paper presents the findings of an institutional study conducted at a higher education institution in South Africa. The analysis is done at the fine-grained level.

Another paper offers a conceptual framework for investigating institutional, personal, and biographical factors influencing student dropout through the analysis of data produced by the mixed methods methodology. This paradigm sheds light on this phenomenon and provides fresh insights, one of which is the connection between subtle institutional violence and this phenomenon (Ramrathan, 2013).

In German higher education institutions, 28% of students drop out of their bachelor's degree programs in any given year. The word "drop-out" refers to someone who leaves the higher education system abruptly without earning a

degree. Statistical estimate approaches are employed to calculate the drop-out rate by utilising cohort comparisons. German research on higher education has seen somewhat diverse developments of theoretical approaches to student dropout, based on Tinto's "student integration model."

These days, drop-out models that characterise the problem as a multifaceted process including individual, institutional, and societal issues that impact students' socialisation during their schooling are preferred. Empirical studies' conclusions indicate that the main causes of dropouts are thought to be difficulties paying for school, an inability to meet the performance-related demands of the higher education institution, false expectations, and a decreased sense of connection with the subject. In response to this circumstance, German higher education institutions and policies implement a range of supportive measures, such as curriculum flexibility, improved student information, and increased support services provided from the start of studies (Heublein, 2014).

Higher education coverage rates are now feasible due to the variety of educational modalities like b-learning and e-learning. But as more students enrol in universities, an increasing number of them drop out, exploding dropout rates. This issue not only has significant national and worldwide economic and social ramifications but also creates circumstances of poverty and marginalisation. The next piece examines the detrimental impacts of academic dropout while also examining the features of big data, a relevant and workable technical option to address this issue. However, the authors also outline the key elements of the Universidad Autónoma de Tamaulipas (UAT) Big Data Analytical Model deployment and its outcomes, which made it possible to pinpoint the reasons and contributing variables of university students' attrition (Amaya-Amaya et al., 2020).

Based on a synthesis of the data in the SCOPUS database, the objective of a different study was to determine the individual, socioeconomic, academic, and institutional explanatory factors involved in student dropout in rural communities. A mixed systematic review was defined using the PRISMA 2020 technique to accomplish this. The findings displayed the factors that have been studied in earlier studies, as well as the distribution of studies by nation, years of publication, kind of document classification in SCOPUS, and methodological approaches utilised in the creation of the studies that were assessed. In this sense, it is stated that the research' conclusions lack importance due to their inability to be generalised due to sample size limitations or pronounced socioeconomic disparities in some countries; Conversely, there is a growing interest in investigating factors linked to personal and scholastic factors to explain rural student dropout rates. Furthermore, a few avenues for future study were highlighted to supplement the present understanding of the dropout event in rural higher education (Guzmán et al., 2021).

Three distinct study success targets are used by national governments and higher education institutions in Europe, as demonstrated by this study on dropout and completion rates in higher education: completion, time-to-degree, and

retention. Different policy instruments are used by national and institutional policymakers to meet these goals. These fall into one of three primary policy categories: monetary rewards; student information and assistance; or organisational concerns. Based on available data, nations with more specific goals, plans, and policies related to study achievement are probably going to have more success. Therefore, study success must be taken into consideration when providing information to (potential) students, offering financial incentives to students and institutions, ensuring quality, and designing educational routes for students. Moreover, it is obviously effective for higher education institutions to take on more accountability for students' academic performance, for instance, in the areas of student selection, matching, tracking, counselling, and mentoring. Lastly, more systematic international comparison statistics and in-depth research of the efficacy of study success policies are required to assist the policy discussion and monitoring of study success evidence (Vossensteyn et al., 2015).

The primary challenge in modernising higher education is striking the correct balance between meaningful outputs and inputs—that is, between the number of enrolled and graduating students. Higher education institutions' strategic policies may contribute to a rise in enrolment, but they may not always improve the grade of education received by their graduates. Therefore, the goal of the authors was to evaluate, using actual data from Latvia University of Agriculture's engineering study program, the reasons behind the first-year dropout rates in higher education. The Proportional Hazard Model of Survival Analysis was utilised to assess the following variables: the gender of the pupils; secondary school grades; the program priority (first, second, or third); and the financing source (self-finance or government-financed). The study's findings indicate that students' lack of secondary school knowledge and lack of desire to pursue engineering are the primary causes of dropouts (Paura & Arhipova, 2014).

Another study looks at the possible reasons why students leave higher education institutions (HEIs) and examines how Lean Six Sigma (LSS) methods may be used to lower dropout rates. Twelve semi-structured interviews with university staff ($n = 9$) and LSS specialists ($n = 3$) were utilised in this qualitative study to get an understanding of the complexities surrounding the student dropout phenomena and the contribution of different LSS instruments to lower dropout rates. Analysis showed that HEIs must keep thorough records and educate pertinent authorities on the consequences of a student's dropout decision to create a typology of student dropouts. The study's modest number of semi-structured interviews is one of its limitations, but the disclosures made by LSS specialists and HEI officials have renewed interest in the subject (Gupta et al., 2020).

There is debate over the relevance of the dropout rate, which is a marker of difficult analysis. Measuring student dropout rates at universities is challenging since there are no systematic, clear procedures for gathering this information. Consequently, different nations employ different formulae to analyse this phenomenon, making comparison research extremely difficult. This paper's goal

was to give a broad overview of student dropout rates in Spain and Catalonia in contrast to those in other international university settings. Data compilation is based on a study initiative financed by the Catalan University Quality Assurance Agency (AQU) and many publications issued by national and international organisations. The viewpoint offered on the many settings in which this phenomenon is being researched and addressed may be useful in developing strategies to improve student performance and retention at higher education institutions (HEIs) (Rodríguez-Gómez et al., 2015).

Even though there are now more students attending higher education institutions (HEIs) than there were twenty years ago, not every student will graduate with a degree. Considering this, institutional analytics (IA) can provide information to aid in strategic planning aimed at minimising the detrimental effects of dropout (such as those on students, academic stakeholders, and institutions). It is unclear; therefore, how institutional stakeholders might use IA in their work to help students who face obstacles in their academic endeavours and to overcome academic-related problems. The authors held focus groups with 13 institutional stakeholders from an Estonian university to close this gap. Through the analysis of the focus group data, they were able to determine three primary categories of characteristics that, in the eyes of institutional stakeholders, influence dropout: (1) institutional experience; (2) educational aspirations; and (3) personal features. To reflect on institutional procedures, organisational structures, and facilitatory functions in the context of dropout in higher education (HE), they have explored their findings from an institutional viewpoint. They contend that to further assist institutional decision-making, IA may offer insights on students' experiences at institutions, their educational objectives, and their characteristics. They see their research results adding to a collaborative agenda for the development, application, and integration of IA solutions targeted at HE dropout prevention (De Silva et al., 2022).

Trends in dropout rates over the past 10 years as well as any prospective shifts in the COVID-19 period were also analyzed. It was examined the variations in those patterns among industries, establishments, and academic disciplines. The average dropout rate has largely grown across all sectors and subsystems, according to the findings, with polytechnics seeing greater dropout rates than universities and private institutions experiencing higher dropout rates than public ones. However, this rise was somewhat more noticeable during the epidemic. Professional Higher Technical Courses (CTeSP) have the greatest dropout rates, whereas integrated master's programs have the lowest. It's interesting to note that, maybe because of the epidemic, bachelor's degree dropout rates have increased recently. However, the percentage of students leaving master's programs has been declining. On the other hand, transfer rates for second cycle master's degrees are usually lower than those for bachelor's degrees, and greater in public universities. All categories of HEIs continued to have good retention rates, often above 80%, and the pandemic did not affect them (Luz et al., 2024).

To guarantee greater graduation rates and lower dropout rates, the model

recommends that factors including faculty, age group, academic status, and cumulative GPA be important. To lower socioeconomic disparities in society, these suggestive findings can guide intervention measures to enhance student retention at HEIs and decrease the gap between graduates and non-graduates (Addison & Williams, 2023).

To pinpoint the specific academic, institutional, socioeconomic, and individual factors that affect rural students' retention and dropout rates in higher education, cross-sectional research was established. A self-report questionnaire measuring 59 factors was given to 269 rural Colombian pupils, making up the non-probabilistic sample. Means comparison and cluster modelling were the foundations of the data analysis. The findings indicate that several factors, including the father's educational attainment, obligations to their family and place of employment, the necessity of moving away from their current residence, the academic average in higher education, satisfaction with the program choice, communication with the institution, and the attention of teachers, are associated with dropout and permanence rates among rural students (Guzmán et al., 2022).

An analysis of student retention and dropout rates in higher education is necessary. Failure scenarios can be avoided with the aid of learning analytics. It aimed to assess the scientific output in this field from higher education publications that are indexed in Elsevier's Scopus and Clarivate Analytics' Web of Science. To get in-depth understanding of the mentioned scientific output, the authors employed a systematic and bibliometric investigation. Authors can determine where, how, and what applications learning analytics has seen in recent years thanks to the data collected. Through the analysis of research conducted globally, they have determined the types of data and methodologies employed in the subject's approach. The authors suggest classifying characteristics, both external and student-related, into several groups and subgroups. Features of the student might be viewed as academic or personal data, whereas information about the university, the surrounding area, and the resources available to students are examples of external elements. The writers effectively apply data mining to the selected educational data to tackle the difficulties. They have also pointed out a few other difficulties that need to be considered in the study, such as privacy concerns (De Oliveira et al., 2021).

A study made by Shiratori (2018) clasifies the state of students in preliminary dropout, normal and good. A good state is when from preliminary dropout the student continues the studies. The analysis based on students' learning data.

A predictive model for dropout in informatics students at TU Wien was developed using meta science tools. There is still an uncertain situation when it comes to the factors that influence students' dropout (Kern, 2024). Also, in Columbia is an issue towards Higher education dropout. It was discovered a statistically significant correlation between an undergraduate Colombian student's likelihood of dropping out and that of their friends (Rocha-Ruíz et al., 2018).

Using the Cox model at the Latvia University of Agriculture, it was found that the dropout rate is influenced by the faculty or subject studied. Also, this rate is higher at Engineering Faculties, where a percentage of 47,6% students abandoned the university studies after their first year, in 2012-2014 (Paura & Arhipova, 2016).

According to Scheunemann et al. (2022) Reducing dropout intentions appears to depend on having reasonable expectations. In addition, student counselors must investigate the causes of academic procrastination more thoroughly to provide customized remedies for this maladaptive habit.

The authors have identified 4 platforms (Table 2) that have the aim to provide academic and career orientation. Even though these platforms offer a solution to better guide a future high school student to universities and socio-economic environment, they can seem extremely complex for users and overwhelming.

As a difference to the existing platforms, the conceptual model proposed in this paper has two interfaces, designed to sustain both academia and future students. As previously mentioned, one of the main benefits of this conceptual model consists in the interface dedicated for the management staff of the university. The data collected from the high school graduates surveys will be displayed as graphs that will provide trends and informed decisions can be taken to sustain future directions of improvement.

Another new feature provided by this platform consists in developing a user-friendly interface to offer a unique user experience for future high school graduates. Even more, they will receive personalized feedback, including detailed information for the specializations recommended to each student.

Table 2. Comparison of existing academic orientation platforms

Platform name	Description	Differences	Disadvantages
U-Explore	Supports students to explore educational options based in their personal interests and abilities.	It offers interactive resources and tools to develop abilities. It focuses mainly on exploring career paths along with educational guidance.	The interface can seem extremely complex for users that are only seeking academic orientation.
Career Explorer	Offers recommendations for career and studies based on a complex test which evaluates the interests and a student personality feature.	It has a broader applicability as it provides support on academic orientation as well as career paths.	The test can be overwhelming and the match with career is general.

University Finder UCAS	Helps students to find university programs that match their interest and academic results.	It focuses mainly on finding the right programs and universities for a student.	It was developed for students from England, being little relevant for other educational systems.
MyMajors	Personalized experience using a questionnaire that evaluates interests, personality, and abilities of a student.	It focuses mainly on linking specializations from universities with the student's profile.	It does not include recommendations on a long term for each suggested specialization.

4. Design of conceptual model of the Web platform

The goal of this web application is to serve two different user types. Firstly, the prospective future student seeking admission to a technical university. The future student is now limited to viewing the degree programs that are offered and the courses covered in each program and unable to choose the one that best fits his needs. This has an impact on the dropout rate. The future student will be able to use the application to choose the best program and apply for it based on his interests, abilities, and the subjects he wants to study. Secondly, the technical university must handle the applications it receives, and have access to a statistics dashboard that shows prospective students' interests (Figure 1).

According to Conceptual Model for Web Platform – Student Interface (Figure 2), they are led through an interest and skill assessment, a tool created to assist students in identifying their interests, strengths, and favourite subjects, after logging in or joining up. Enquiries concerning their preferred topics in high school, interests, and desired careers may be part of this evaluation. The application recommends a list of bachelor's programs that fit the student's profile based on the evaluation findings. Every suggested program comes with a synopsis, a list of the main topics it covers, suggestions for future career choices, and endorsements or success stories from previous students. The program specifics section includes an interactive curriculum map that gives a thorough overview of the courses and skills taught in each program for those who want a more in-depth look. Clicking on a subject will provide students with further information, including project examples, course materials, and possible real-world uses. Students may also evaluate several programs side by side using the application's comparison tool, which considers elements including course content, job placement rates, and necessary abilities. The career path insights section, which includes data on alumni outcomes, offers information on the kinds of professions or chances for additional study that each program usually leads to, to further assist students in making an educated choice. Through student community forums, where prospective students may interact with current students and graduates or debate their options with peers, the application also encourages involvement and support.

The University Staff Interface (Figure 3) shows the quantity of applications received, the most well-liked programs, and patterns in student interests. Administrators may view comprehensive candidate profiles for each application, including the outcomes of the student's interest and skill assessments. This makes it possible to communicate with candidates in a more tailored way. Additionally, the platform incorporates communication features that let administrators set up interviews, send emails, and give candidates feedback right from the system. The platform has a special component for managing programs, where academic staff may edit course descriptions, program data, and other information that students can see. The statistics and analytics board also provides insights into the demographics of applicants, including their location, gender, and previous education, in addition to data visualisations that highlight the most popular subjects and programs among potential students. The institution can efficiently handle and evaluate student applications and interests thanks to this extensive toolkit.

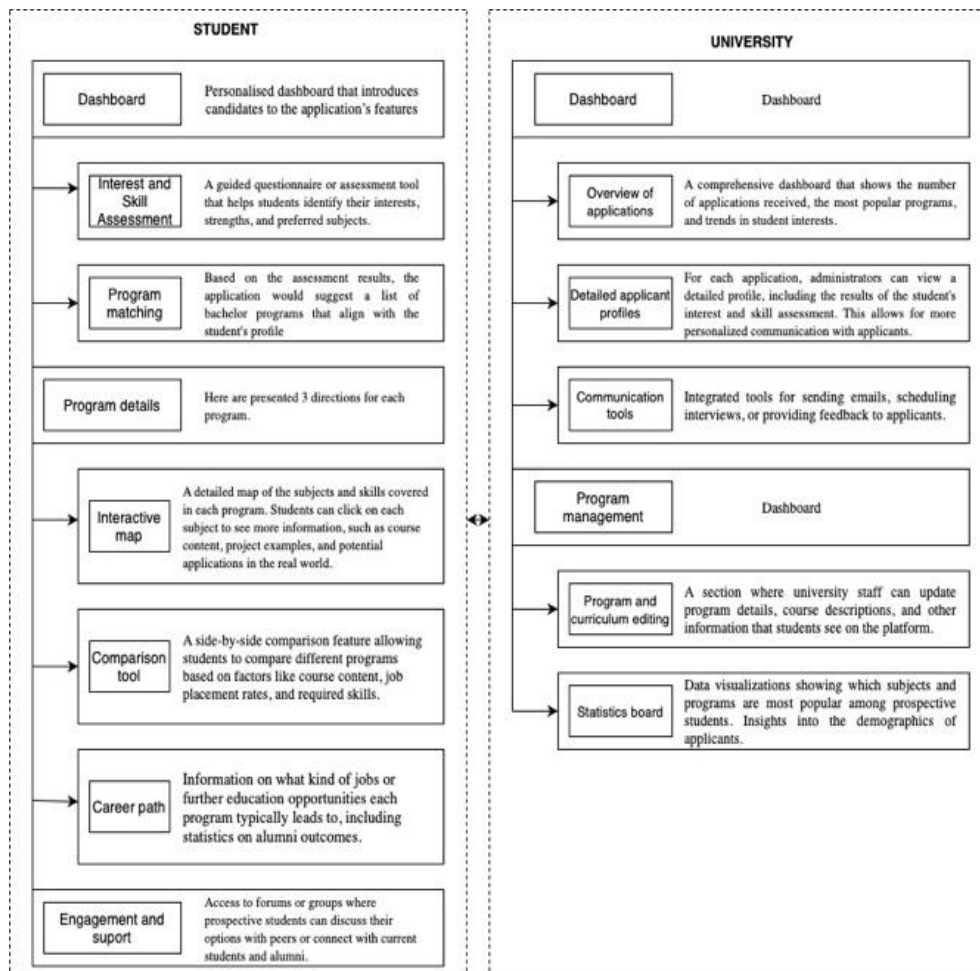


Figure 1. A conceptual model for the Web platform

Future students' application starts with a customised welcome on the dashboard or homepage, where they are met with an interface that walks them through the platform's capabilities (Figure 2).

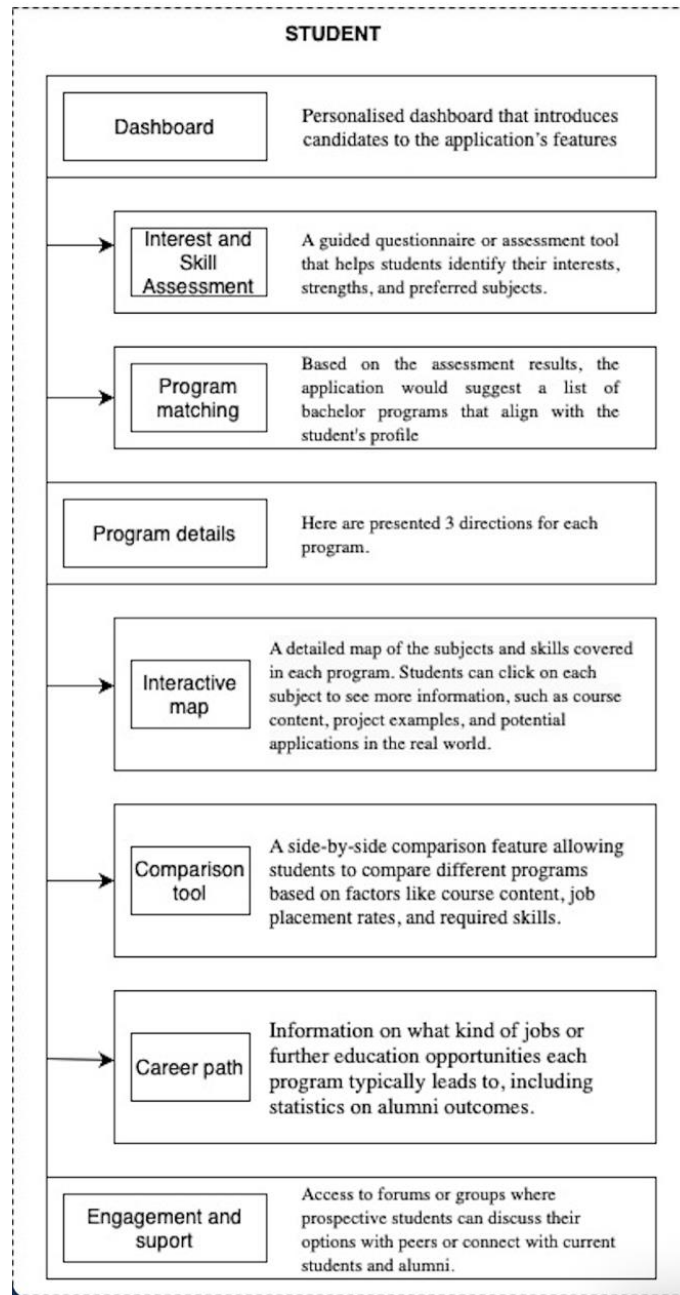


Figure 2. Conceptual Model for Web Platform – Student Interface

The application has an administrator dashboard (Figure 3) that offers a thorough overview of applications from the viewpoint of the technical institution.

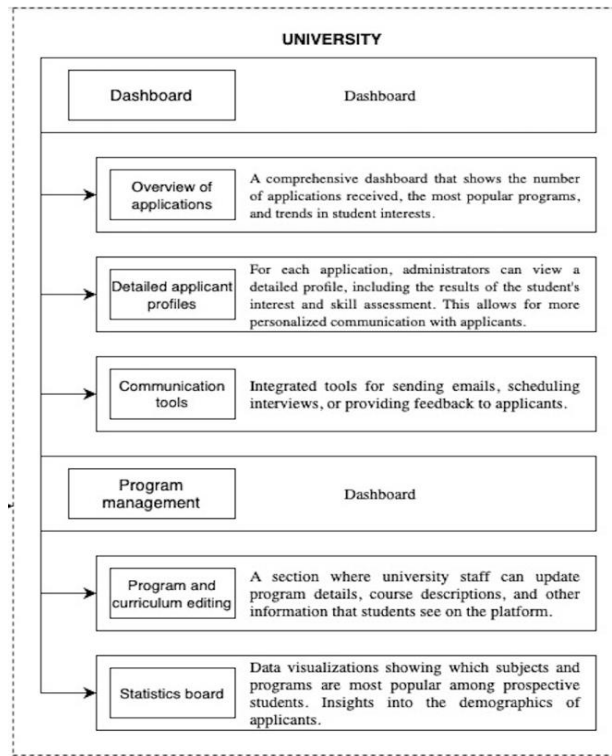


Figure 3. A conceptual model for the Web platform – university staff interface

5. Conclusions

While research has been done on dropouts in higher education, the integration of smart guidance and digital technologies is a new and promising approach. Thus, the platform model proposed in this paper brings more originality and novelty to this field, contributing to the development of knowledge and the application of innovative solutions to decrease dropout in technical higher education.

The conceptual model of the web platform was designed to meet the needs of pupils who have finished high school and want to choose a bachelor's program and university. Thus, each future student can view the programs within a technical faculty and, based on an online test, see which of them suits him/her best. At the same time, he/she will be able to access testimonials from graduates of the programs in order to make an informed decision. The goal is for the future student to apply to a program which meets his/her requirements to avoid the possible dropout. At the same time, the platform also has an interface for the faculty, so that teachers who have access can update the information. They will also be able to see

the results of the tests given by future students in order to analyze the data and help them in the registration process. Through a board dedicated to statistics, members of the faculty management will be able to see the preferences of future students, as well as other indicators dedicated to analysis.

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