Analysis of Features and Abilities of Online Systems and Tools Meeting Information Needs of HEIs' Entrants

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Abstract. The paper presents information systems analysis in the educational domain that fulfil information needs of university entrants regarding their admission to higher education institutions (HEI). This process is one of the key stages during the enrollment campaign and directly affects the trajectory of potential students. The main purpose of the analysis is to determine the basic functionality of the system that would provide candidates with the necessary information, as well as the opportunity to evaluate their choice applying for university admission. An analysis of recent studies has enabled to determine the main trends in the implementation of such systems. Considering the popularity of using commercial software solutions that provide support for the enrollment campaign, their typical functionality was analyzed. The open sources for entrants (their content, the typical functionalities of the official web resources) of leading universities in Europe and the most popular educational resources are also analyzed. Based on the results of the analysis, the general requirements for the functionality of the system were formed. An online resource model built on such requirements will consider the information needs of the potential user and will be the basis for improving the future performance of the system.

Keywords: Higher Education Institution, University, Enrollment, Applicants, Website, Machine Learning, Prediction System.

1   Introduction

Fulfilling the modern generation's consumer needs and wants with the rapid development of information technologies is one of the main tasks of HEIs. The high competition in the educational services market necessitates a clear understanding of the peculiarities of the behavior of both real and potential students. Therefore, one of the priorities of the university is to find and implement the most effective technological solutions - their software development or specialized solutions [1, 2, 3].

It is needed to emphasize one of important mechanisms of functioning of HEI - the enrollment campaign. It is a complex process that requires proper organization and support of modern information technology tools. The critical point for both the university and those interested in enrollment is the choice of a specialty to obtain an educational qualification level.

The way and the efficiency of the course selection that is made by candidates will directly influence the quantitative and qualitative set of entrants, that is the key to the high rating of the educational institution. The success of graduates is a significant factor in shaping the university popularity and is also a consequence of the rational choice of future students. In addition, every year there are more and more new courses, so the choice of university and field of knowledge is not always the result of a considered personal, professional, and educational self-determination of applicants.

Since that choice significantly influences both the activity of the university and the further educational and professional trajectory of the potential student, there is a need for a more detailed analysis of this issue. It is advisable to consider existing information systems in the field of higher education that meet the information needs of applicants for admission to higher education.

2   Literature review

Analysis of current scientific research shows that most of works is focused on data mining methods and obtaining the most accurate results in predicting the results of entrants during admission process. Typical to compare different forecasting methods to obtain the most accurate results. For example, comparing different regression algorithms [4]; development machine learning model and ensemble [5] machine learning methods that consider the use of multiple approaches, which gave better results than each of them individually.

In this paper [6], the authors identified the main problems faced by entrants: lack of sufficient information about university's proposed courses and the difficulty of choosing the most appropriate course for study. A new admission recommendation system was created. A method based on a hybrid neural network, decision tree, and a separate algorithm developed by the authors was proposed.

In this study [7], was proposed a recommendations system to make predictions for students' choices based on their marks and job interests. Clustering technique was used to find structures and relationship within the data This paper also describes the process of preparing such a recommendation system.

In [8], the authors consider the choice of educational institution and course as a long and complex process for entrants. This research focuses on creating a recommendation system that consider the benefits of college and at the same time analyzes the user profile. The authors compared several approaches to solving the problem and identified random forest with regression as the most effective.

A considerable amount of work has been done in the field of Educational data mining (EDM), which explores the process of using data exchange tools and methods for data analysis in educational institutions. It is a separate area of research with its

journals [9], conferences and the scientific community. Such research is based on data generated by various systems that is integrated into the learning process. To have a clear understanding of the areas of research in this field, many significant analyzes have been carried out, confirming the important contribution and importance of such studies [10, 11, 12 ,13]. Most of the developed methods and models are intended to investigate the profiles and behaviors of students or entrants and, accordingly, to predict their success. [14, 15, 16, 17].

The above-mentioned works demonstrate the importance of the issue to achieve right choice of field of knowledge or course and give sufficiently clear results that contribute to the needs of both the university and the entrant. The authors highlight benefits such as: reducing the time and finances of an entrant to choose a course; the selection boards could spend less time processing applications; reducing the risk of choosing the wrong field of knowledge etc. However, the main purpose of such research is to apply the methods chosen to obtain the most accurate result. Not enough attention has been paid to analyzing the user experience or the basic functionality of the system.

3   Basic features of web resources for entrants

Online representation is a powerful tool for marketing and market positioning of universities. Leading universities are constantly improving and expanding the functionality of the University's Web sites and are one of the key factors for its success in the global information environment [18-23]. It is advisable to study the practices of developed European countries to effectively analyze the educational activities of the university, as regards the introduction campaign. Therefore, according to the Webometrics Ranking of World Universities in Europe we analyze the experience of the 20 most successful universities in Europe [24].

3.1   HEI's official website as a tool for information support of entrants

Analysis the official sites of the selected universities allowed to make some conclusions about their content and basic functionality.

It is worth to highlight the following features of information content that describes admission process in higher educational institution:

- all universities provide information in the public domain.
- description of educational courses is structured according to the institution's proposals.
- programs of courses are published with fully description that is enough to understand the scope. The main emphasis in the content is on enabling the entrant to become fully familiar with the course structure.
- formal requirements for candidates are formulated to avoid misunderstanding of the required documents.

The admission process in all cases involves a possibility to use apply to university online. This kind of system includes all stages, including payment. They are easy to use and must be paid for. Katholieke Universiteit Leuven in Belgium (www.kuleuven.be), École Polytechnique Fédérale de Lausanne in Switzerland (www.epfl.ch), University of Groningen in Netherlands (www.rug.nl), University of Oslo in Norway (www.uio.no) have its web portal for applications and admission.

It should be noted that in some cases, online process of applying to university is made by external systems. The reason is the peculiarity of the organization of the educational process of a country. For example, in the UK, there is a Certified Bachelor's Degree Program and Universities and Colleges Admissions Service, UCAS (www.ucas.com). It's worth noting that King's College London (www.kcl.ac.uk) combines this resource with its software solution, King's Apply (www.kcl.ac.uk), where user accounts are integrated with UCAS. Applicants can track the status of their applications, find out whether they have been interviewed, receive system alerts, apply for residency etc. Similar service to UCAS is able in Denmark - Optagelse (www.optagelse.dk), in Finland – Studyinfo (studyinfo.fi). All non-private HEI in the Netherlands can use Studielink (www.studielink.nl).

A common practice is online consultations conducted to coordinate candidates in the rational choice of course of study or college. User information interests are collected in advance by filling out an online questionnaire. The University of Edinburgh (www.ed.ac.uk), Oxford (www.ox.ac.uk), Cambridge (www.cam.ac.uk), London Universities have introduced this service for entrants. For example, a specific college can be advised in case candidate is interested in sports, because it is more developed there. However, the disadvantage is the impact of the human factor.

Utrecht University in Netherland provides an online comparison service for master's programs [25]. Based on the official names of specialties entered by the user, a summary table of formal requirements is formed. This format has the great advantage in its usability in contrast of being single-page viewer. However, this opportunity is only available for one educational level. Ghent University (Belgium) has also expanded the standard specialty search tools [26]. Here user can choose a course at the intersection of several branches of knowledge. Such a service is appropriate as well as there could be a case where an entrant may mis-associate a field of expertise with a profession. École Polytechnique Fédérale de Lausan offers online service guidance that helps applicants to make a choice. Based on a set of six user-selected images, the system generates areas of research that may interest him. It is obvious that such recommendations are more a means of marketing and the level of accuracy is too low. The University of Edinburgh offers similar specialties that might interest the entrant next to his or her choice - a block with the name adjacent appears on the specialty description page.

3.2 Information support of HEI's enrollment campaign using commercial software solutions

Over the last 10 years had actively developed commercial software solutions aimed at admission management system. Today, such products are quite popular with potential

its customers, most of which are educational institutions. The analysis of the information about the customer of such software (from the pages of their official websites) indicates the existing demand for such software solutions. Therefore, we consider it appropriate to consider them as meeting the needs of the target audience.

Such companies as Blackbaud (www.blackbaud.com), Ellucian Company(www.technavio.com) and Hyland Software (www.hyland.com) are key software providers in the global software market. In addition to their products, the most popular paid solutions were also reviewed according to the Capterra website [27]. In terms of user experience, the functionality of such systems is typical and includes, in particular:

- automated application process.
- deadline control during the introductory campaign, a notification module for users.
- paying for online tuition.
- the user's account and profile page.
- user-friendly and branded interface.
- mobile app versions.
- collect, save, search for data, reporting tools and analytics for administrators.

Instead, the difference between commercial software is end-user groups; the number of users that the system is capable of servicing; operating systems that can be deployed and accessed (web-based or installed); cost.

Availability of mobile version and branded interface for each educational institution, ease of use and several analytics tools are important benefits in terms of usability of these solutions. For administrators, such software undoubtedly also has advantages, including: fast and transparent recording; the ability to use the data for further processes; integration with other information systems (schools or colleges, ERP, management of the educational process of university); reducing the need for material and human resources in the course of the introductory campaign.

However, most decisions are focused on the very process of accepting and processing applications from applicants. In addition, there remains the problem of privacy and data security. Also, for many universities, the problem is the high cost of purchase and the difficulty to support them. Paid solutions are mostly more popular in the US and only partially in Europe. This necessitates significant changes to the software, which, for example, is not financially viable from the point of view of Ukrainian universities.

4   Suggested structure of the web service for information support of entrants

Based on the analysis, we can determine the basic requirements and functionality of the system - a web service that will provide candidates with the necessary information, as well as the ability to evaluate their choice when applying to university.

The main objective of a comprehensive web resource is to meet the information needs of the user that will facilitate the rational choice of a specialty to gain their educational degree.

Most of the target audience of such a system are entrants - in most countries those who have graduated from school and received the appropriate certification document. However, the entrant gets acquainted with the university long before the start of the admission campaign. Therefore, a group of potential users of the web service also includes those who are interested in admission. Basic functional requirements of the system that support entrants' informational needs are as follows:

1. Compliance of the system with the admission rules according to the current legislation of the country and the specific educational institution.
2. Advanced search for educational courses that include not only basic fields that are identic to formal admission requirements but also the additional feature that will help the user to fully understand the content of the educational offer.
3. Predicting the success of the results in the rating list of applicants, where:
    a. the most effective prediction methods have been applied.
    b. the external factors of the current situation within the country and the university have to be included (market needs, etc.).
    c. algorithm calculations during the introductory campaign will consider changes in the arrival of new entrants in real time with each new applicant.
4. Selection of alternative specialties in accordance with the interests of the student, the formal requirements of the admission rules and user profile data.
5. Availability of mobile version of the system.

According to these requirements, the feature web service should consist of the following basic components:

1. User management.
2. Automated educational information retrieval system.
3. Predicting the success of the user position in the ranking list of the introductory campaign of the current year.
4. Selection of alternative specialties that meet the interests of the user.
    To execute these processes, the required in this web service objects are external and internal data repositories containing both historical data and newly created ones, among which (See Fig.1):

- "university" - a university-specific database that serves as a source of educational information provided to users upon request. It should include, for example, data on educational offerings, archives of admission campaigns, quantitative formal indicators in accordance with the current year's admission rules (minimum passing score, subject weight, licensed volumes, etc.) and data on current students.
- "external DB" - as a source of official progress data for the current enrollment campaign. It is conditional because such information can be collected by the university itself - it depends on the education system of each country.
- "user" - as a site visitor and requester.

- "users" - as a database that stores information after the user registration process, while being a source of information for other system functions.
- "website content" - as an internal object of the system that stores up-dated information and is a source of data when the user interacts directly with the web service.
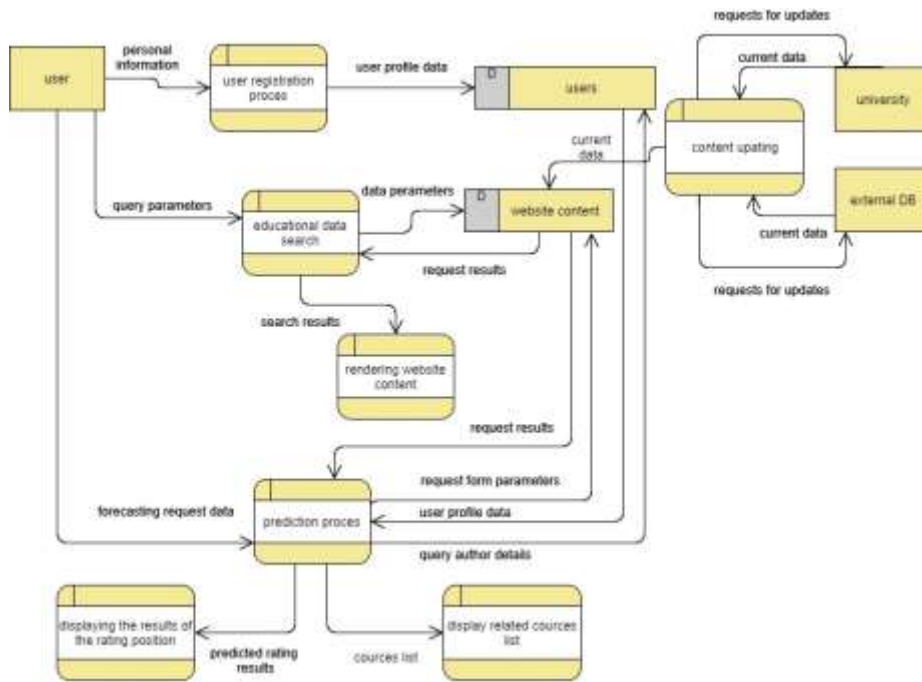
Fig. 1. Data flow diagram of online service to support entrant's information needs.

The predictive model should be built using computing intelligence methods. During interaction mode, the user will make a request that has to include a part of the attributes that are required in the building attributes model. The other part will be taken from the website's updated content database. As a result of applying the trained model to the data of a user, he will get the probable value of his future rating position and, if necessary, a related specialty. The forecasting model should re-train with the change of the current year's rating lists or other important constituents.

5 Recommendations and future directions for research

Scientific researches show that they are based on data relating to a particular university and even the level of education, for example, for masters-level of a particular course or graduate students from abroad. The reason is the different entry conditions in each country, or even the university (e.g. in the USA). This makes it

impossible to apply identical methods to other universities. This leads to the need to carry out the following stages of designing the information support service for entrants, considering the peculiarities of the education system of a particular country and admission conditions of a particular university.

To build a component of the search for educational offerings, it is necessary to extend the typical functionalities that are mostly based on formal characteristics. It is necessary to define the basic criteria that would meet the needs of potential users, the interests of the modern generation and at the same time descriptions of the specialties themselves. This will help to reduce the risk of the wrong association in understanding the offer of the applicant. It is advisable to identify the areas of expertise and those specialties that are at the intersection.

An analysis of the practices already applied in this study proves the relevance and high efficiency of the use of forecasting methods to assess the applicant's success in admission. A separate direction of future research should be aimed at comparing different approaches to the solution of the forecasting problem and determining the most effective ones.

In order to build a forecasting model, it is also necessary to explore a variety of independent traits that will affect the outcome. It is necessary to carry out a detailed analysis of possible tangible sectors, since the limited number of indicators considered in the calculations has a negative impact on the results. Thus, there is a need for further research into the target audience, taking into account the behavior of the modern generation; determine the interests of the university; trends and current state of the market for educational services, the economy of the country as a whole. Based on the results of such studies, those factors that significantly influence the forecast outcome will be selected. They will be included in the training sample. Further design of the system should consider the ability to integrate and process large amounts of data and identify tools and methods that would not reduce the performance of the system.

Given that the choice of a prospective student may be incorrect due to lack of awareness of the specialties themselves, it is advisable to carry out a more detailed study in the field of EDM, in the context of forming an offer of an alternative choice of specialty. Analyzing the profiles of full-time students, namely the enrollment data and their current academic performance, will allow comparison with the profile of the user of the future system. This can be an argument for selecting related user specialties and extending the functionality of the systems.

6   Conclusions

Meeting the information needs of the entrant is one of the priority components of a successful HEI 'admission campaign. This study discussed online tools of information support for those interested in an admission which to some extent affect contribute to the effective choice of future students. Analysis of the literature shows that typical solutions are the use of data mining methods that ultimately show high accuracy. It is important to consider all the issues that could influence the results of the effectiveness

of the web service that will use the selected method. So, the necessary following step is considering the peculiarities of the education system of a country and admission requirements of a university. Another required direction of future research, which was defined in this study, is comparing different approaches to the solution of the forecasting problem and determining the most effective ones. In order to build a forecasting model that will provide an opportunity to evaluate entrant's choice applying for university admission it is also necessary to define and explore a variety of independent traits that will affect the outcome. Existing accessible modern solutions offered by leading universities in Europe show, that the software their entrants could use, does not sufficiently support the user in the decision-making process for choosing a course. The main disadvantage of such services is the low accuracy of the results. Instead commercial solutions provide broad enough functionality. However, the cost of buying and supporting them is quite high. Therefore, there is a need to build the system in such a way as to minimize university costs and at the same time include a wide list of functionalities. The choice of specialty for future students today is a topical issue and is considered as a factor that significantly influences the activity of the institution and at the same time the further educational and professional trajectory of the potential student. The construction of a web service that would provide appropriate information support to the entrant requires complex approaches and the search for the most effective methods.

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