Algorithm for Forming the Offer of Educational Services by Higher Education Institutions to Improve the Technology of Processing Educational Content by Potential Entrants

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Abstract

The aim of this article is the algorithm for forming the offer of educational services by higher education institutions. This will improve the technology of processing educational information by potential entrants. The article examines the formation of the offer of educational services by higher education institutions that based on the concept of related connection of specialties of higher education institutions. The possibility of additional informing potential consumers of educational services about the availability of specialties that are relate to the chosen specialty was established. The article formed a differentiation of related groups for the chosen specialty in accordance with the possibility of other specialties to replace it during the entry campaign based on the interests and motivational intentions of potential entrants. The article proposes an algorithm for forming the offer of educational services of a higher education institution for potential entrants on the basis of available certificates of external independent evaluation. It established in the article that the expansion of the offer of educational services provides additional information to entrants about the availability of specialties that have a related connection of group I, II, III to the chosen specialty. The results of the study are used and can be used for effective planning of educational services by higher education institutions and forecasting the contingent of students during the entry campaign.

Keywords 1

Entrant, related connection, external independent evaluation, entry campaign, educational information, offer of educational services.

1. Introduction

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Higher education institutions (HEI) are the center of professional development of young people today. The entry campaign is the first stage of professional choice for the younger generation, which is based on the interests and motivational intentions of potential applicants. An indicator of the range of interests of potential entrants is the available certificates of external independent evaluation (EIE).

Potential entrants choose a specialty or institution of higher education during the entry campaign. The main indicator of the choice of potential applicants is the quantity and volume of these priorities. Potential consumers of educational services do not always have complete information about all specialties for entry with existing EIT certificates when they choosing a higher education institution. This is because HEIs annually update the catalog of educational services and open new promising specialties for entry. According to the results of the study [1], some specialties of HEI are not popular among consumers of educational services. Moreover, the number of entrance applications and enrolled applicants does not cover the licensed volume of the specialty.

Given the fact that for different specialties of higher education there is a certain set of certificates, it can be argued that there is a need to further inform potential consumers of educational services about the availability of all specialties that take into account their interests. This, in turn, provides an

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opportunity to expand the offer of HEI' educational services for potential entrants and the opportunity to get an answer to the question "where can I go with the available certificates." It also creates an opportunity "not to lose your student" for HEI. That is why the article proposes to improve the technology of processing educational information for entrants of higher education institutions during the entry campaign on the base of existing specialties of higher education and the range of interests of potential consumers of educational services.

Thus, the aim of this study is to improve the technology of processing education information of higher education institutions for potential entrants during the entry campaign.

The results of the study can be used to improve the user interface of reference systems of higher education institutions for potential applicants. This forms the practical significance of the research work.

2. Related works

The process of choosing a specialty and HEI takes place long before the official conduct of the entry campaign. Communicative activities during the entry campaign [2, 3] and the establishment of feedback [4] form the perception of potential applicants about existing specialties and HEI in general [5-6]. In particular, the importance of the impact of communicative activities of participants in the educational process in the web space is the subject of research [7]. In [8-10] the algorithm of the choice of discussions of the virtual community suitable for influence on internal information space are presents.

Motivational intentions of potential entrants [11-13] and social influences [14-16] are directly involved in the process of choosing a specialty or HEI future entrant.

During the entry campaign, the HEI must take into account the factors that influence the formation of demand and supply of educational services, taking into account the global dimension of the HEI [17,18] and its strategic management [19-22]. In particular, taking into account the factors influencing the process of choosing a higher education institution by a potential entrant allows determining the mechanism of influence on the formation of the student body and the multilevel process of creating an information image of the university [23-25]. Continuous monitoring of the quality of the entry system [26-29] and quality control of information activities on the Internet [30-33] is a necessary condition for the effective and competitive operation of higher education institutions in the market of educational services.

Existing studies of planning the provision of educational services are bases on the formation of the offer of educational services and identifying the dependence of the choice of specialties in accordance with the motivational intentions of potential entrants to predict the contingent of consumers of educational services based on the entry campaign. Nevertheless, none of the studies considers the improvement of educational information processing technology for entrants to higher education institutions during the entry campaign based on additional information to entrants about existing specialties, taking into account their interests, which forms the relevance and novelty of this study.

3. The concept of related relations and its types

Potential entrants gets acquainted with the offer of educational services of the HEI, when they choosing a specialty and / or a higher education institution. In the general case, the offer of educational services for potential entrants has the form [1]:

$$Edu \operatorname{Pr}oposition_{i} = \left\langle \begin{array}{c} Entry Year, Spec_{i}, EduLevel, EduForm, Department_{i} \\ Entry Cours_{i}, LicQuantity_{i}, Edu \operatorname{Pr}ogram_{i} \end{array} \right\rangle$$
(1)

where EntryYear – year of entry, $Spec_i$ – the *i*-th specialty in the list of preparation of HEI, EduLevel – education level, EduForm – form of education, Department – the department of the HEI, which carries out training, $EntryCourse_i$ – list of HEI's subjects for entry to the i-th specialty, $LicQuantity_i$ –

license quantity of the i-th specialty, $Edu \operatorname{Pr} ogram_i$ – information about the educational program of the i-th specialty.

Each specialty has a related connection to the other one.

A related connection is the ability of one specialty to replace another during the entry campaign without affecting the interests of the potential entrant.

According to the related connection, specialties can divided into the following groups:

Group I is the specialty with a strong connection. Such specialties have the same compulsory subjects and elective subjects for passing the external independent examination.

Group II is specialties with secondary connection. The same list of compulsory subjects of external independent evaluation and one of the elective subjects characterize these specialties.

Group III is specialties with a weak connection. One of the compulsory subjects is in the list of elective subjects of another specialty, and the elective one is the compulsory one characterize these specialties.

Group IV is specialties without related connection. These specialties cannot replace each other during the entry campaign, as the sets of required certificates are completely different or only one of the subjects from the total set coincides.

Types of related connections of specialties are presents in Помилка! Джерело посилання не знайдено..

Table 1

Types of related connection

Specialty subjects	Compulsory subject	Elective subject 1	Elective subject 2	Elective subject 3
HEI specialty				
Group I				
Group II				
Group III				
Group IV				

Specialties that belong to groups I, II and III, given the opportunity to enter one of the specialties that take into account the interests of potential entrants with existing certificates of external independent evaluation. That is why HEI has the opportunity to expand the offer of educational services for potential entrants and fully meet the needs of consumers of educational services, taking into account their interests.

Thus, the expanded offer of educational services by higher education institutions during the entry campaign has the form:

$$Entry Edu \operatorname{Pr}oposition_{i} = \begin{pmatrix} Entry Year, Spec_{i}, Edu Level, Edu Form, Department, Entry Course_{i}, \\ \operatorname{Re} late Entry Course_{i}^{(I,I,III)}, LicQuantity_{i}, Edu \operatorname{Pr}ogram_{i} \end{pmatrix}$$
(2)

where EntryYear – year of entry, $Spec_i$ – the i-th specialty in the list of HEI, EduLevel – education level, EduForm – form of education, Department –department of HEI, $EntryCours_i$ – list of subjects of HEI for entry to the i-th specialty, $RelateEntryCours_i^{(I,I,III)}$ – specialties that have a related connection of groups I, II, III in relation to the i-th specialty of entry. $LicQuantity_i$ – license quantity of the i-th specialty, $EduProgram_i$ – information about the educational program of the i-th specialty.

Thus, the expansion of the offer of educational services provides additional information to entrants about the availability of related specialties that have a related connection of group I, II, III. This allows

improving the technology of processing educational information for entrants to the HEI during the entry campaign.

This approach, on the one hand, has significantly expanded the opportunities to entry for potential entrants depending on the subjects of external independent evaluation, and on the other is to increase the number of potential entrants for specialties that are not very popular but are no less important for the chosen specialty or meeting the needs of potential applicants.

4. Algorithm for forming the offer of educational services by higher education institutions

The formation of the offer of educational services by higher education institutions for potential entrants during the entry campaign is based on the availability of the necessary certificates of external independent evaluation. The algorithm for forming the offer of educational services takes into account only the presence of a related connection of group I, II, III, as they can satisfy the interests of a potential entrant. Since the subjects that form II and III groups of the related connection do not differ in the number and actual list of subjects, so in the algorithm of forming the offer of educational services of HEI are derived by a common set of specialties. Formation of the offer of educational services of HEI for potential entrants occurs on the following steps:

1. $EntCourse_l$ is the set of available certificates of external independent evaluation of the l-th potential entrant.

2. *HEICourse*_k is the set of HEI specialty ($k = \overline{1, N(HEICourse)}$).

3. *IRelCourse* is the set of specialties that have a related connection of group I.

4. *IIRelCourse* is the set of specialties that have a related connection of group II and III.

5. For each i-th specialty of HEI we define a set of subjects which are common for a set of certificates of external independent estimation of the potential entrant and the certain list of subjects for entrance on i-th specialty of HEI.

6. If

 $EntCourse_{i} \cap HEICourse_{i} = \langle MainCourse_{i}, \{SelectCourse_{ij}\} \rangle_{j=1}^{N(SelectCourse_{i})}$

then this specialty belongs to the group I of related connection. So we form a set *IRelCourse*. 7. If

or

$EntCourse_{i} \cap HEICourse_{i} = \langle RelSelectCourse_{i}, RelMainCourse_{i} \rangle$

 $EntCourse_i \cap HEICourse_i = \langle MainCourse_i, SelectCourse_i \rangle$

then this specialty belongs to the group II or III of related connection. So we form a set *IIRelCourse*.

8. We check and i+1 is the next specialty of HEI $(i > N^{HEICourse})$, and return to paragraph 5.

As a result of the algorithm for forming the offer of educational services of the HEI according to the available certificates of external independent evaluation, the potential entrant receives a list of specialties for entry, which take into account the range of his interests.



Figure 1: Block diagram of the algorithm for forming the offer of educational services of a higher education institution for entrants

Thus, the proposed algorithm for the formation of the offer of educational services of higher education institutions allows potential applicants to obtain a list of all possible options for specialties to enter the selected HEI. On the part of the higher education institution, the proposed algorithm makes it possible to expand the offer of educational services for potential entrants and forecast the contingent of students during the entry campaign. This allows to improve the technology of processing educational content for potential entrants to higher education institutions.

5. Analysis of the results

Analysis of the results of the entry campaigns of the Lviv Polytechnic National University for the period of 2017-2020 shows that the most popular specialty of these years is "Computer Science". It is worth noting that one subject defined by the rules of entry is compulsory for all specialties, which is why it does not affect the possibility of expanding the educational service (note - as of 2020 it is "Ukrainian language").

For the specialty "Computer Science" the compulsory subject for entry is "Mathematics", and the elective subjects are "Physics" and "Foreign Language".

Thus, one of the related specialties for entry to the specialty "Computer Science" is "Systems Analysis" (compulsory subject is "Mathematics", elective subjects are "Physics" and "Foreign Language"). These specialties have a related connection.

The specialty "Public Management and Administration " in relation to the specialty "Computer Science" has a related connection of group II, as a compulsory subject for this specialty is "Mathematics", and elective subjects are "Foreign Language" and "History".

The specialty "International Economic Relations" in relation to the specialty "Computer Science" has a related connection of group III (compulsory subject is "Foreign language", elective subjects are "Mathematics" and "Geography").

These specialties of related connection of the groups I-III can give the entrant the opportunity to enter the selected HEI with certificates required for the specialty "Computer Science". Specialty "Law" (compulsory subject is "History", elective subjects are "Geography" and "Biology"), in relation to the specialty "Computer Science", has a related connection of group IV and can not meet the needs of applicants to obtain the desired qualification with the available EIE certificates. That is why this specialty does not take part in additional informing of potential entrants who have chosen to enter the specialty "Computer Science".

Analysis of the dynamics of applications for the specialty "Computer Science" and specialties that have a related connection of groups I-III with this specialty, for the entry campaigns of 2017-2020 according to the educational portal https: //www.vstup .info / represented on Fig.2. They shows that for the specialty "Computer Science" and the specialty "Systems Analysis", which has a related connection of group I, there is a positive trend in the choice among entrants in 2017-2019 and not a significant decline of interest among entrants in 2020. And in the specialties "Public Management and Administration", "International Economic Relations", which have a related connection of groups II and III in the specialty "Computer Science", there is a decrease in interest among entrants during the entry campaigns 2017-2018 and the growth of interest in these specialties (on average by 6%) during the entry campaign of 2019-2020.

Analysis of the dynamics of enrolled applicants and the available license quantity of the specialty "Computer Science" and specialties that have a related connection of groups I, II and III with this specialty, for the entry campaigns of 2017-2019 according to the educational portal https: // www.vstup.info/ represented on Fig.3. They shows that the number of enrolled entrants to specialties that have a related connection of groups I, II and III with a specialty "Computer Science" does not cover the licensed quantity of training specified for this specialty.

Moreover, the number of enrolled entrants to the specialty "Systems Analysis" (group I) is growing steadily, and for the specialties "Public Management and Administration", "International Economic Relations" there is a tendency to reduce the number of enrolled students during the entry campaigns 2017-2018 years and the growth of interest in these specialties (on average by 3%) during the entry campaign 2019-2020.



Fig. 2. Dynamics of applications for the specialty "Computer Science" and specialties that have a related connection of groups I, II and III for the entry campaigns of 2017-2020, according to the educational portal https: // www. vstup.info/



Fig.3. Dynamics of enrolled entrants and the available license quantity of the specialty "Computer Science" and specialties that have a related connection of groups I, II and III for the entry campaigns of 2017-2020 according to the educational portal https: // www .vstup.info /

Thus, the improvement of the technology of processing educational information for potential entrants during the entry campaign on the basis of additional informing potential entrants about the availability of specialties with related connection of groups I, I, III with the chosen specialty allows HEI to regulate the number of enrolled students is the opportunity to study in the selected external evaluation with the available certificates of external evaluation, taking into account the range of their interests.

6. Conclusions

Thus, the competitiveness and functional efficiency of the HEI in the market of educational services depend on the strategic behavior of this HEI during the entry campaign. That is why the article introduces the concept of a related connection between the specialties of the HEI, which can satisfy the interests of consumers of educational services, taking into account the range of its interests. This made it possible to improve the technology of processing educational information for potential entrants during the entry campaign on the basis of additional informing potential entrants about the availability of specialties that have a related connection of groups I, I, III with the chosen specialty. The article establishes the influence of additional informing potential entrants during the entry campaign on the positive dynamics of applications and enrolled consumers of educational services on the example of "Computer Science" and specialties of the Lviv Polytechnic National University which have a related connection of groups I, II and III for the period of entry campaigns 2017-2020.

Analysis of the results of the study of the dynamics of applications and enrolled applicants on the example of the specialty "Computer Science" and specialties that have a related connection of groups I, II and III with this specialty shows the positive dynamics of these indicators after using the proposed approach to improving processing technology educational information for potential entrants during the entry campaign (on average by 5% for applications and 3% - for enrolled applicants). This allowed HEI to regulate the number of students in the specialty taking into account their interests and entrants is the opportunity to study in the selected HEI with available certificates of external independent evaluation.

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