Web-Based Service Development for Intellectual Maintenance of the Personalized Educational and Professional Program

Adaptive provision of educational services in academic mobility context through automated improvement of quality and relevance of tutorial content

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Abstract — **The results of empirical analysis of conceptual sources in the direction of educational methods comparison for optimizing the teaching loads for engineering education applicants are presented. Disadvantages and potential conflicts of trainee when mastering of educational and professional program content are formalized, in particular within academic mobility frameworks, as well as in view of the rapid increase in the number of academic refugees. Among the recommended ways of solving problems with academic arrears accumulation, is the information and communication technology of matching the optimally combined educational content to soft compensate for the knowledge and skills that student's lacks. The relevance of automated quality improvement and propriety of tutorial content is substantiated, and sets of software functionalities of web-based service for teaching loads personalization are determined, which were localized by departments of academic information space for purpose of integration into a united cross-academic communication system. Proposals regarding the reorganization of the structure of digitized methodical and information supports of the educational process according to the mosaic principle have been formulated. On basis of the developed analytical apparatus, a communication model of the network infrastructure of teaching loads optimization service was built, which provides a targeted selection of tutorial media content from problematic domain of subject in file storages of university library collections and confidential faculty funds and distributes according to the forms of educational process on the end terminal of the authorized user.**

Keywords — information and communication technology; academic mobility; web-based service; computirized learning system; profiled tutorial content; reinforcement learning.

I. INTRODUCTION

Management of the productivity of educational services provided today remains a primary problem due to the growing claim for qualified professionals with an engineering degree. An imbalance between basic knowledge and necessary pre-competencies can have negative consequences when potential applicants choose targeted educational and professional programs. In the meantime, the primary task of higher education institutions is to maintain proper standards of the services provided for further prosperity and popularization among rival organizations. Especially considering that service quality is a priority to achieve student satisfaction along with justified expectations and perceived university values [1].

In order to ensure stability in the educational services market, access to resources, increase the expectations of interested parties, implement the concept of student-centeredness and compliance with key wishes and requirements of employers, a higher education institution should highlight clear prospects for mastering the offered educational and professional programs in such a way as to interest the student and meet his expectations and by no means do not scare him away with excessive teaching loads. Such a moment of encouragement in setting priorities for improving the design of educational system services lies primarily in requirements transparency for the life cycle organization of educational and professional program and acquired competencies assessment, being the main source of competitive advantages in the long term [2].

Therefore, teaching load optimization is the main factor in the attractiveness of educational and professional program and the attraction of loyal trainees, within the frameworks of physical and virtual academic mobility. However, the average applicant usually lacks the skills and life experience to comprehensively weigh and adequately compare his or her capabilities regarding the narrowly specialized aspects of the curriculum offered by the dean's office.

The successful implementation of adequate client-server analytical means of personalized support, and the generation of context scenarios in decision-making on the selection of targeted educational content will help to establish priorities in determining the necessary components and reduce the risks of academic arrears when drawing up the individual study plan.

II. JUSTIFICATION OF THE RELEVANCE OF INTELLECTUAL SUPPORT SERVICE DEPLOYMENT FOR PERSONALIZED EDUCATIONAL AND PROFESSIONAL PROGRAM

A. Analysis of the last research and problem statement

The problems of involving computer technologies to encourage students to innovative career trajectories, the specifics of introducing educational initiatives with flexible adaptation to goals and strategies of the interactive international community are the subject of careful study by domestic and foreign researchers from various fields. In particular, ways of engaging intelligent systems to enhance cognitive capabilities and self-regulation are considered in a number of publications. Thus, the effectiveness of multi-

feature fusion modelling use [3] and intelligent agents with humanized interfaces and simulation of social experience [4] is realized when the student makes targeted tuition decisions to achieve maximum productivity, better support the process of building knowledge and increase the effectiveness of learning by visualizing a personalized space with multiple choices [5]. Multimodal analytics tools [6], ease the cognitive load, enhance the effect of engagement and allow focusing of productive attention on the most relevant information at the right time.

Another publications category focuses on the design and implementation of intelligent systems for the acquisition, analysis and selective visualization of teaching data in online educational environments. Thus, the application of advanced predictive AI architecture and corresponding software means for collaborative activities [7] expands strategies to ensure automatic and effective student learning. Similarly, AI based on artificial immune systems [8] implements the selection of an individual study plan for each student when working in laboratories for collective use.

The use of artificial intelligence-based automated systems covering different levels of experimental pipeline [9] is successfully applied in the decision-making process to ensure academic integrity during online exams. Intelligent systems implementation in education helps students visualize engineering concepts in a multidimensional way [10] to better interpret knowledge and stay attentive and focused on a subject.

A few research also consider methods of formalizing recommendations for choosing an educational course, which are traditionally based on knowledge [7], on context [11] or by adding the expert knowledge and sparseness regularization in computation [12]. However, above and other publications of same type practically do not pay attention to targeted selection of personalized tutorial content based on gaps available to applicant. Also, the problem of flexible multidisciplinary training at individual pace while comprehending optimally selected portions of information remains almost is unexplored. Therefore, there is actual need to design original client-server solutions for the complex provision of situational educational services with an optimal approach to portion-wise compensation of the trainee's missing knowledge and skills in understanding the topics content of educational and professional program by constant acquisition and analyzing the level of their preliminary training within academic mobility frameworks, avoiding stress and excessive teaching loads.

B. Study of shortcomings and potential conflicts in credit transfer

With a conscious choice of educational and professional program, the main problem facing the student is an adequate assessment of future teaching loads in an objective assessment context of one's own capabilities [13]. Such choice is especially difficult for academic mobility programs participants, who are generally not familiar with institution specifics and experience difficulties to credit transfer. The procedure for granting credit to educational experience is often delayed due to university policies and non-compliance with the requirements of the chosen speciality; therefore, very often a student cannot expect to receive advanced standing. Along with other psychological and social barriers, such uncertainty does not contribute to the popularization of

target educational and professional program and institution in general. In order not to lose the academic offer, the educational establishment must make organizational, teaching and scientific efforts to the interest of academic mobility programs participants.

Certain positive solution to the described situation is transparent priorities in existing academic arrears liquidation within scope of applicant's independent work without increasing of study period. The rational expansion of targeted educational and professional program with careful counselling and additional materials involvement and gradual proceeding of practical lessons ultimately comes down to course subject understanding at individual pace, taking into account one's own productivity peaks, which will significantly increase of external trainees self-motivation.

Recent publications analysis showed the absence of unified model and insufficient automation of described algorithm in many educational institutions. Despite the many years of teachers experience and legal awareness of regulatory experts, the human factor physically limits all nuances consideration when expanding the proposed educational and professional program and adapting it to applicant needs, especially academic mobility participant. Therefore, the authors in presented research focused exclusively on technological aspects of adjusting the methodological attributes of educational course. Therefore, the designed technology purpose of intellectual support the trainee's individual educational trajectory as organic component of university information space is to optimally combine sufficient tutorial content to compensate for student's missing knowledge and skills when mastering a curriculum. The main result of developed information and communication technology for teaching loads optimizing of engineering students is automated generation on-topics-point personalized content with flexible alignment of academic gaps according to training level.

C. Definition of components the personalization teaching loads service

Comprehension of teaching filling of any educational and professional program requires the student to have a certain amount of knowledge and skills in a specific subject area. This experience amount is necessary for the comfortable assimilation of specific industry-oriented tutorial content and competencies provided by educational standard and accreditation requirements.

For the initial assessment of existing knowledge, the degree of its selectivity and detail, coverage and uniformity, and ability that can be applied in practice, a computer criterion-referenced pre-testing in the form of a cycle's series of multidisciplinary formalized tasks is conducted

If the mark received when solving the cycle of tasks does not exceed the normative indicator intended for establishing the qualification pre-level applicant's for an academic course, the analytical apparatus of teaching loads personalization service forms a subset of lacunar descriptors D_i according to competencies missing from i-th domain of subject. In this way, the set of gaps is accumulated.

Therefore, the relationship of each element of such a subset with its corresponding fragment of tutorial content is formed, which is properly indexed and stored in C library collections of institution or F faculty confidential funds of

unpublished tutorial materials. Indexing criteria are determined by speciality educational standard according to the competencies list.

Depending on the training edition purpose and educational process organization form, its content is used to understand T theoretical information, perform P practical lessons or L laboratory tasks. Separate means of learning in practical lessons are E interactive exercises to consolidate certain theoretical provisions of academic discipline. The remote immersive platforms of learning experiment M are environments for preparation and, if possible, the full implementation of laboratory works for the acquisition and improvement of professional skills.

Thus, the lacunar descriptors set from the problem domain of the subject, distributed by educational process forms, can be presented in the following way:

$$D=\{D_i \{T \{C_T, F_T\}, P \{C_P, F_P, E_P\}, L \{C_L, F_L, E_L, M_L\}\}, ...\}. \quad (1)$$

The specialization of virtual laboratory application environment as a distributed means of providing remote educational services [14] is determined by the list of *iLib* software libraries that will dynamically connect to media platform and provide a targeted If_K user interface with an adequate T_K toolkit:

$$M_L=\{iLib, If_K \{T_K\}\}. \quad (2)$$

Scenarios of computerized environment of interactive exercises for laboratory or practical work according to situational lesson pack [15] are also presented by targeted user interfaces:

$$E_{P,L}=\{Pack, If_K \{T_K\}\}. \quad (3)$$

As mentioned, indexed sections of help service $\{C_L, F_L\}$ and $\{C_P, F_P\}$ quickly provide the context of drop-down tooltip the T_K toolkit and links selection in expandable area the If_K application window. For full-fledged organization of scientific and educational conditions, similar selection of profiled methodical materials is delivered to end terminal of computerized educational system for authorized user.

III. WEB-BASED SERVICE'S FUNCTIONALITY DISTRIBUTION BY ACADEMY INFORMATION SPACE DEPARTMENTS

Finally, in process of direct deployment of the designed client-server network infrastructure, there was a need to determine the responsibility frameworks of executive departments the educational institution in administration of information flows for web-based service of intellectual maintenance of personalized educational and professional program. The cooperation protocols that function currently in the academic educational space are not fully provided for integration into a unified cross-university communication system.

First, it is necessary to reorganize the methodological and information support of the educational process, which is kept in the institution's digitized storages. Such tutorial media content should be fragmentally indexed according to the mosaic principle, so that each fragment contains a minimum amount of knowledge from a completed part of a certain topic of the subject field [14]. As mentioned, the indexing criteria are established by the educational standard of the specialty in accordance with the list of competencies. Then the multidisciplinary pre-test from the university *knowledge control unit* will flexibly determine academic retard and compile a list of unique identifier for direct access to fragments of media content (Fig. 1).
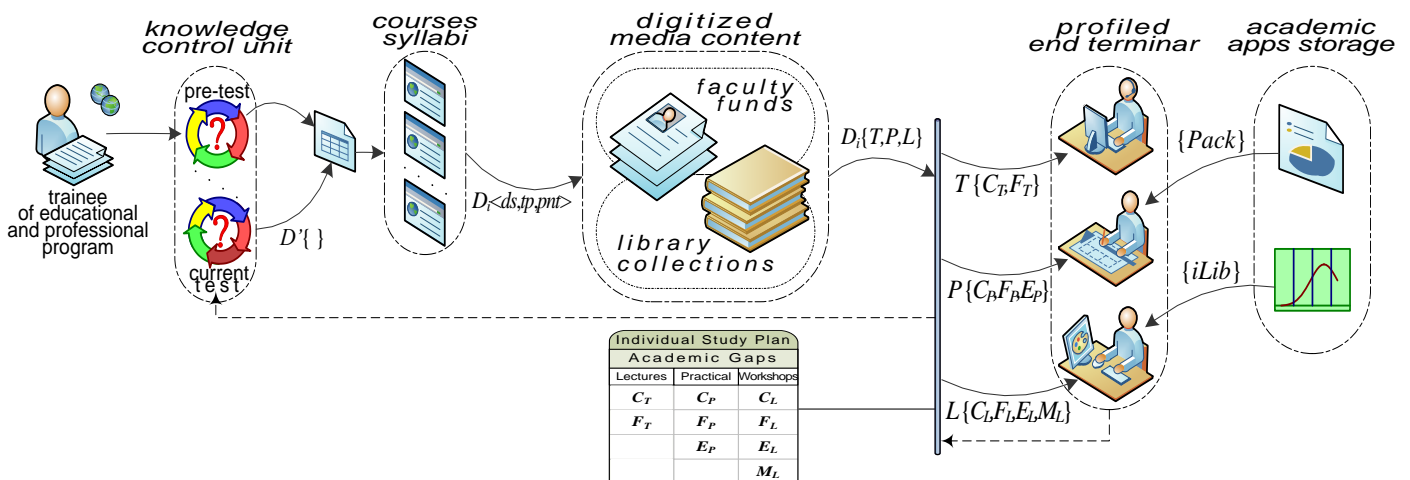

Fig. 1. Communication model the network infrastructure of teaching loads optimization web-based service.

These preliminary composed lacunars descriptors list must presently be reconciled with existing *courses syllabi*. Next, specified designators, pointwise identified in course topic context <*ds,tp,pnt*>, are used to address the corresponding tags in target *digitized media content* files. The analytical apparatus of academic information space performs directional choosing of file repositories in university library collections and confidential faculty funds of graduate departments. Performed

sampling gives the lacunars descriptors the final set from the problem subject's domain, distributed by educational process forms (1), which is the basis for further scenarios for the intellectual maintenance of the personalized educational and professional program and is added to applicant's electronic *individual study plan*. Also, after appropriate filtering, the sub-elements of this set initiate targeted tutorial content in *profiled end terminal* workspaces, for which all storage access permi-

ssions must be provided in correspondingly configured group policies containing preferences of automated workplace parameters [15]. As noted, interactive exercise environments and learning experiments computerized platforms are also specialized by corresponding nested elements indicated from lacunar descriptors set, pointwise identified in course topic context. Such specialization occurs at the initiation of appropriate software libraries (2) and situational lesson packages (3) from *academic apps storage* with remote work possibilities. Also, in these environments, access to the *knowledge control unit* is provided for actual verification of acquired competencies, which is shown by the dotted arc on the communication model (Fig. 1). Properly, feedback is implemented in this way, which allows determining the progress in working out academic gaps for a studied topic. After a positive or negative shift in the trainee's skills, lacunar descriptors set is automatically updated. Therefore, engineering profession applicant can always be sure of receiving sufficient tutorial media content in full in accordance with his current competence level. Such teaching loads dispersal on course topics, together with optimally combined methodical and information support provision, in every possible way contributes to soft compensation trainee's missing knowledge and skills and motivates to search for relevant innovative career growth routes.

IV. CONCLUSIONS

Based on world practices analysis and common educational methods comparison for teaching loads optimizing of engineering profession applicants, the unified model absence and insufficient automation in targeted selection process of personalized tutorial content given on student's existing gaps were revealed. The research was conducted on formalization ways of shortcomings and potential conflicts the trainee in educational and professional program mastering, in particular within academic mobility frameworks, as well as in view of a rapid increase in academic refugees' number as open aggression result and full-scale enemy invasion with educational services provision suspension in temporarily occupied territories and in a combat zone. The communication model of the network infrastructure of teaching loads optimization software has been built, which in contrast to the traditional approach of eliminating the academic gap is supported by developed analytical apparatus and provides tutorial media content targeted selection of problematic subject domain from file stores structured and indexed according to mosaic principle and dispensed to forms of educational process for end web terminal with access through an integrated cross-academic information system, thereby levelling out the potential barrier of the trainee in mastering the educational and professional program.

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