Composing a Syllabus via Educational Program Maker: A Web Tool for Academic Documents Creation

Polina Shnaider*, Anastasiia Chernysheva, Anton Govorov, and Maksim Khlopotov

***Abstract*—This paper raises the question of the importance of syllabus structure. The research conducted on syllabus components allowed for a thorough analysis of the learning analytics literature, leading to the identification of the main components of the course model and the interrelationship between them. Based on these findings, a web service called the Educational Program Maker was developed. This tool has proven to be notably useful at ITMO University in Saint Petersburg, Russia since its launch in March 2021. It has gradually become the primary instrument for creating academic courses at the university, playing a crucial role in effective communication among educational process participants during the design, development, coordination, and approval of the syllabus. The Educational Program Maker follows a course model that is presented and discussed in this study. Feedback from faculty members who have used the tool has been evaluated, and the results are promising. The Educational Program Maker is not only making the process of creating syllabi and academic documents easier, but it is also improving the quality of these documents and fostering collaboration and communication among educators.**

***Index Terms*—Learning analytics, syllabus structure, academic course development, educational program maker**

I. Introduction

Creating descriptive academic course documents such as syllabi is a complex process. The resulting document should establish effective communication between instructors and students and ensure that the content meets all national educational standards. Syllabi are essential for the educational process, as they are a major factor in determining the content of courses and curricula in any academic field.

To ensure convenient and effective interaction between all parties involved in the design, development, coordination, and approval of syllabi, an electronic system should be created to replace the traditional paper-based workflow. This system should optimize the process at all stages and ensure effective communication between instructors, staff of the department of educational activities, and other involved parties. Additionally, the system should be able to accommodate both full-time and semi-remote forms of the educational process, as well as the necessary organizational processes.

This paper presents Educational Program Maker [1], a web tool for academic document creation and verification being developed and utilized at St. Petersburg's ITMO University. It covers the entire common syllabus composition process, automating as many steps as possible; makes the whole process transparent and provides useful tips and recommendations for teachers and reviewers along the way. Once completed, students have open access to the curriculum materials.

In addition to computerizing routine syllabus creation steps, Educational Program Maker transforms discipline keywords, which are usually optional, into a mandatory step. This creates a network of academic courses, and can offer insightful suggestions for teachers based on previous user data and experience.

The reminder of this paper is organized and structured as follows: In Section II, studies related to syllabus structure exploration and analysis are reviewed. The syllabus model implemented in the Educational Program Maker is then revealed in Section III and its key features are addressed in detail in Section IV. Finally, the user experience and future of the project are discussed in the Conclusion.

II. Literature Review

In recent years, there has been a trend toward the digitalizing the creation of academic courses. Klugman *et al*. [2] conducted a survey among one hundred twenty-four baccalaureate and ten graduate programs "to assess existing programs' experiences and needs". The results confirmed "interest in and need for a descriptive toolkit as opposed to a prescriptive manual". Nataly, Riaño, and Forero [3] also focused on the "construction of a model tracking curriculums through technological systems".

An example of the mentioned technological system, the Canvas Learning Management System (LMS), can be considered. It is used by instructors worldwide for syllabus creation. Aldiab *et al*. [4] describe how the Syllabus Tool in Canvas allows instructors to create a visually appealing and interactive syllabus and embed multimedia content, such as videos and audio recordings, which can enhance student engagement.

Though Google Docs have never been a specialized tool for syllabus development, its collaborative features and peer-editing activities allow instructors to work with colleagues to create and revise syllabi.

Zhu *et al*. [5] mention "shared access and permissions that allow for social annotation of documents." According to Zhu *et al*. [5], "technology environments can support collective reading and discussion, with the potential to deepen understanding of the materials."

In addition to Canvas and Google Docs, several other web tools can be used for syllabus creation, such as Blackboard, Moodle, and WordPress. Bates [6] outlines how Blackboard

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and Moodle are LMS platforms that offer a variety of tools for syllabus creation, including multimedia content and interactive activities.

Numerous educational institutions worldwide constantly attempt various automation in creating educational programs, for instance, providing intelligent guidance and constant feedback.

Mariela *et al*. [7] oppose classic documents "written in a human-readable format" without automatic processing and guidance to "intelligent services [with decision-making] to support teaching and learning." Moreover, Mariela *et al*. [7] emphasize that intelligent online tools "will facilitate the interchange of [academic course] data between different services and applications."

Burian *et al*. [8] discuss building capacity in higher education in developing countries. They suggest "introducing instruments to guide, review, and provide feedback on creating syllabi, lesson plans, learning activities, assessments, and teaching". The article examines the impact of these instruments on course development and delivery. Similarly to [4], they describe their experience with Canvas.

The next question that logically arises is the educational plan structure. Which parts should it consist of to meet the needs of teachers, students, and future employers? As claims Elena *et al*. [9], market stakeholders, when hiring fresh graduates, want to know if, during the education, they acquired skills that are "essential for the performance and the modernization of the labor market." Kowligi *et al*. [10] similarly agree on the importance of following market tendencies and suggest that "the [academic course] assessments and evaluations should be tied to … incorporate "real world experiential projects".

Kevin [11] suggests that the syllabus should include basic course information, instructor information, course goals, materials and requirements, information about grading and assessment, course policies, and course schedules/calendar. Providing that all the mentioned sections are present in the academic course structure, students understand what they will need for successful course completion and what they will learn.

Besides that, research has shown that students prefer interactive and engaging syllabi. Moosavian [12] found out that "a well-designed interactive syllabus can bring about many advantages such as ... causing better retention; needing less cognitive energy for interpretation; helping instructors identify any snags in their course organization; capability of being integrated easily into a course management system; appealing to many of learning styles and engaging students with different learning styles."

Garavalia *et al*. [13] and Farrow and Leathem [14] discuss surveys conducted among university students and teachers on the most valuable syllabi components. According to Garavalia *et al*. [13], faculty members and students differed significantly in their perceptions regarding 15 of the 39 possible curricula components. For instance, students give much more value to the presence of examples of completed projects/papers than teachers do [13]. In [13], both teachers and students gave one of the highest values to the "grading scale for final course grade" and the fact that "the syllabus should contain a listing or schedule of topics that are covered in the course," which are supposed to provide more transparency to the educational process. Farrow and Leathem [14] came to slightly different conclusions. According to them, students see the most value in "student assignments explanation" and "instructor information," which partially correlate with the findings of [13].

Eicher and Joyner [15], similarly to [13], stress that at the very beginning of the course, students need to understand not only what they are going to be learning over the term but also how the entire process is going to work and what they need to do to make the most of it. The study suggests that every syllabus should have components that act as:

- A "Communication or Signaling Device"—an explanation of how the class/course will run.
- A "Contract"—a binding document describing the expectations of both the students and the instructor in various study-related behaviors, such as being late or plagiarism.
- A "Learning Tool"—the way students master given material.
- A "Permanent Record"—an ability to serve as proof of exactly what students learned or did in a specific course.
- A "Filter"—all the information necessary to make a timely and informed decision about whether to enroll in a class.

Farrow and Leathem [14] emphasize that syllabi built using UDL (the Universal Design for Learning) recognize the diversity of learners and seek to optimize teaching and learning for each individual student. As a result, students are better engaged and are likely to receive higher grades. A study examined 33 syllabi from schools and determined the most and least prevalent UDL elements in construction syllabus. Areas of highest UDL inclusion were course length, student resources, and course calendar. The lowest scores were in areas related to assignment information. Authors conclude that the study results suggest improvements in syllabi that may better meet UDL criteria and better align with student syllabus preferences.

The reviewed works point to a tendency toward digitizing curricula. Special attention should be paid to the structure and content of curricula, as it serves as a bridge of communication between instructors, students, and other key stakeholders. It can also facilitate the development of a more personalized learning experience, tailoring instruction to the needs and interests of the individual student. Thus, it can be concluded that the digitization of curricula is a promising approach to improving the quality of education and achieving desired learning outcomes.

III. Methods

Analysis of related work revealed the following main components of an academic course model and their relationship.

A. Sections and Topics

Each course contains several sections, types of tasks that students must complete to master the discipline, and the number of hours allocated to each section and task. Each section covers a range of topics.

B. Prerequisite Skills and Learning Outcomes

Apart from unsupervised text descriptions of syllabus contents, a set of prerequisite skills and learning outcomes can represent each academic course. Earlier, in [16] (Maria Koshkareva *et al.*), an approach was presented to describe any subject area or course as a set of keywords. Testing showed that the methodology is a convenient solution to determine general components of an educational entity and detect closely related domains. Furthermore, using these sets of skills, individual learning pathways can be effectively created for students or valuable recommendations provided. Each prerequisite, along with learning outcomes, forms an interconnected skills network.

C. Literature Sources

This section contains educational and methodological literature, articles, scientific and practical publications, and software related to the academic course.

D. Evaluation Tools

The section outlines the evaluation tools used in the discipline. All tasks assigned to students are accompanied by an evaluation tool. Each evaluation tool should be linked to the learning outcomes of the discipline, demonstrating how the stated results are being achieved.

E. Evaluation Tools for Intermediate Certification

This section describes the various assessment activities for the exam, pass-fail exam, or differential pass-fail exam that will be conducted at the conclusion of the course. These assessments are designed to accurately assess the student's knowledge and understanding of the course material and will be used to determine their final grade.

F. Online Courses

This section describes the online courses that must be completed to master the discipline.

G. Competencies

For each competence indicator, expected knowledge, abilities, and skills are provided. Learning outcomes for each level of mastery are described in detail. A competency matrix is then formed and added to the curriculum, reflecting how courses affect students' mastery of the curriculum.

IV. Result

The proposed syllabus model implemented at ITMO University through Educational Program Maker enables instructors to create a comprehensive description of the course content, which is made easily accessible to students. This facilitates efficient communication between all participants in the educational process, providing students with the necessary information about their curriculum and the courses they are currently enrolled in.

Students can read both general information (e.g., whether a course is mandatory or not, its start semester, and academic credits) and more detailed information (e.g., entry requirements, literature, and examples of assessments).

Next, a more detailed syllabus information will be discussed. The perspective of a university professor will be considered, as this work not only aims to describe syllabus structure, but also to focus on the guidance provided by Educational Program Maker when filling courses with data.

At the start, the instructor is prompted to enter basic information about the course (Fig. 1 and Fig. 2): title, language, format, responsible department, duration, program level, and academic credits with evaluation tools for each semester.

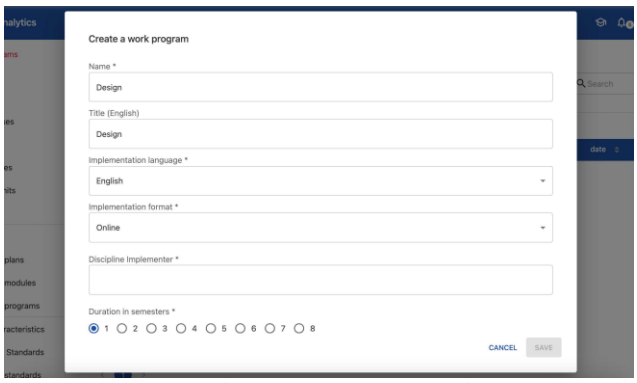


Fig. 1. Basic information about the course (first part).

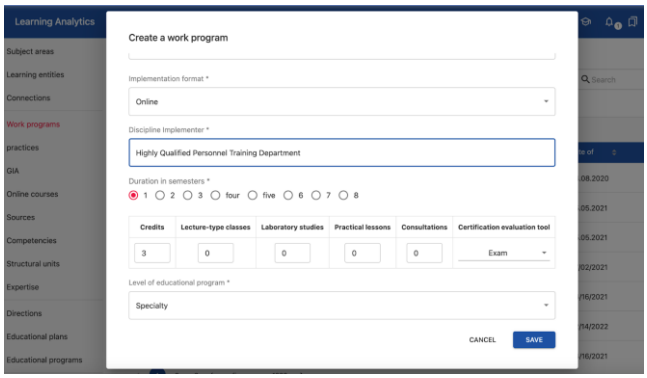


Fig. 2. Basic information about the course (second part).

After the initial data is filled, the instructor is redirected to the Discipline Creation Wizard (Fig. 3). This wizard guides them through the steps of creating a detailed course in a coherent manner.

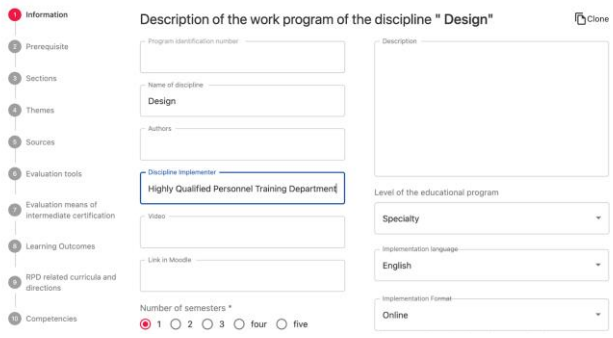


Fig. 3. Discipline creation wizard.

Fig. 3 shows that some of the data in the "Information" step is sourced from the modal dialog filled earlier.

Besides the "Information" step, the wizard has "Prerequisites," "Sections," "Topics," "Sources," "Evaluation tools," "Learning outcomes," "Related curricula," and other steps. Filling data through the same sections makes creating disciplines convenient and easy to follow and helps standardize syllabi. This ensures that every ITMO University academic course has the proper format, no

crucial data is missing, and can be shared with other university services.

The next step after "Information" is "Prerequisites". It specifies the entry requirements for students enrolling in an academic course. Prerequisites (Fig. 4) are educational entities from various subject areas, describing what a student should know before enrolling. For example, courses in algorithms and high-load programming may require knowledge of Java programming language or experience with version control system Git.

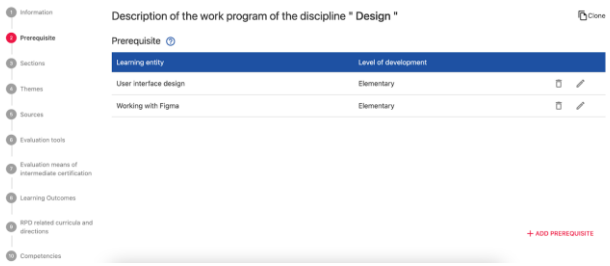


Fig. 4. Academic course prerequisites.

When defining course prerequisites, instructors must identify the level of mastery (Fig. 5): elementary, medium, or high. It is assumed that the curriculum is designed in such a way that students' mastery of a particular subject increases gradually. Initially, students gain a basic understanding of the subject and then progress further.

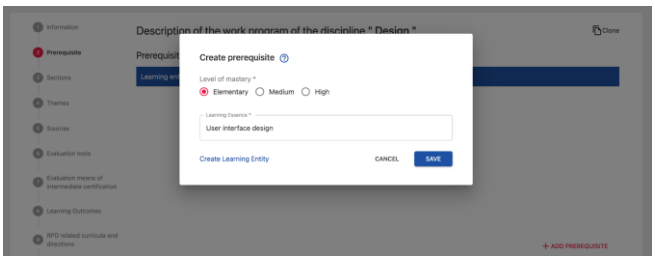


Fig. 5. Adding prerequisite of specific level.

Constant work is carried out to improve the user experience provided by Educational Program Maker. The goal is to give the end user as much decision-making support as possible. To that end, a recommender model for course prerequisites has been developed. This model suggests instructors' course prerequisites based on the history of interactions with the service. A matrix factorization technique via Alternating Least Squares (ALS) is used for making prerequisite suggestions, as described in paper [17].

Once the prerequisite data is filled out, the instructor moves on to the "Sections" step, where they can outline the course topics. They can enter the titles of all essential course topics, along with the number of lectures and practical lessons devoted to each.

Educational Program Maker provides a built-in hour's calculator (Fig. 6) to help instructors easily determine if there is an adequate amount of course material.

Educational Program Maker is intelligent enough to enable only relevant fields. For example, if the user indicated that they are creating a syllabus for an online course, they would not be able to enter data into fields specific to offline formats. This subtle decision-making assistance helps instructors focus on the most important aspects and provides a seamless experience for those who have limited experience in creating academic courses.

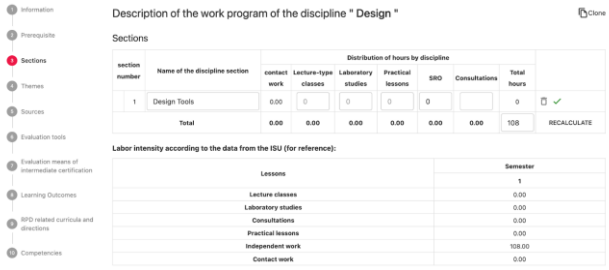
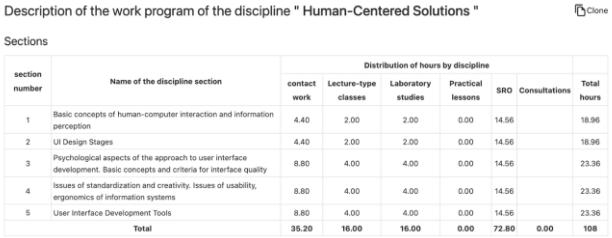


Fig. 6. Hours' calculator.

A more detailed description of a course helps students gain a better understanding of their academic workload and topics covered during the semester. Fig. 7 shows the syllabus for "Human-Centered Solutions," which consists of five topics with varying hour allocations. Completing the two sections requires fewer hours than the other topics. The instructor only needs to enter lecture-type classes, laboratory and practical lessons, and consultations (if applicable) into the calculator; the rest of the fields are calculated automatically based on the data provided.



section number	Name of the discipline section	Distribution of hours by discipline						
		contact work	Lecture-type classes	Laboratory studies	Practical lessons	SRO	Consultations	Total hours
1	Basic concepts of human-computer interaction and information perception	4.40	2.00	2.00	0.00	14.56		18.96
2	UI Design Stages	4.40	2.00	2.00	0.00	14.56		18.96
3	Psychological aspects of the approach to user interface development. Basic concepts and criteria for interface quality	8.80	4.00	4.00	0.00	14.56		23.36
4	Issues of standardization and creativity. Issues of usability, ergonomics of information systems	8.80	4.00	4.00	0.00	14.56		23.36
5	User Interface Development Tools	8.80	4.00	4.00	0.00	14.56		23.36
	Total	35.20	16.00	16.00	0.00	72.80	0.00	108

Fig. 7. Hours' distribution of an academic course with lectures and laboratory classes.

The next step (Fig. 8) allows us to provide more details about the course structure previously described. Each topic may have subtopics, and Educational Program Maker allows instructors to add study materials to each of them. It should be noted that Educational Program Maker is not a Learning Management System (LMS) and is not intended to provide a comprehensive theory for every topic covered. However, adding a summary for every subtopic can act as a permanent record, as mentioned in [15], so that students can later review a detailed summary of what they have learned. Furthermore, they can use it to prepare for practical classes.

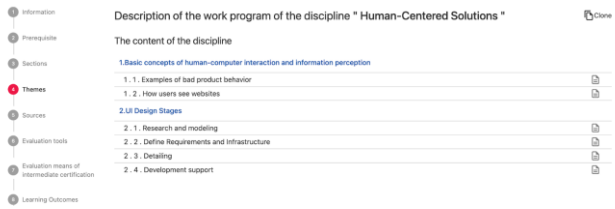


Fig. 8. Expanding course sections: topics.

Literature sources are an integral part of the course curriculum. Students should be aware of what they can read beyond the theory materials provided by their instructor. They may be interested in specific course topics and eager to gain a deeper understanding of technology than what is implied by the course materials, or they may feel they have knowledge gaps that need to be filled. For this reason, the Sources section is mandatory when creating a syllabus using the Educational

Program Maker.

Users can select literature sources from EBSCO, the leading provider of research databases, e-journals, and e-package subscription management, or choose literature items previously added to the Educational Program Maker sources database by other users. This is represented by the EBSCO and Analytics tabs on Fig. 9.

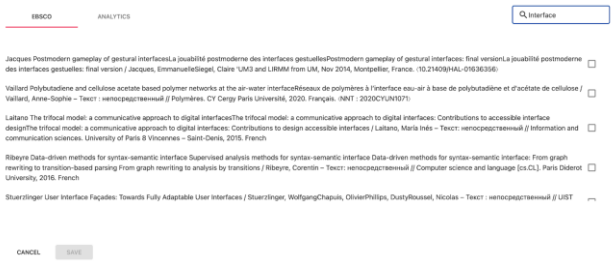


Fig. 9. Literature selection from EBSCO or existing sources.

After adding literature sources, instructors must specify course evaluation tools (see Fig. 10). This section outlines all graded tasks that students must complete during the semester.

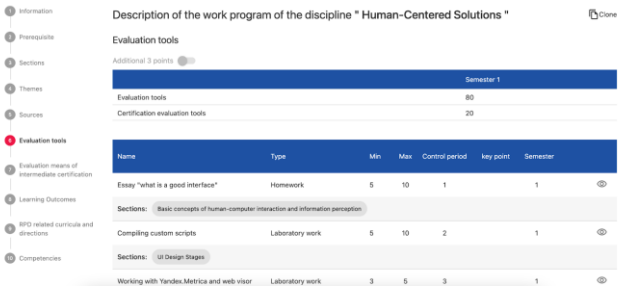


Fig. 10. Course evaluation tools.

Each evaluation tool item provides comprehensive information, including the type of task, minimal and maximal grading, deadlines, and the course section to which it refers.

Fig. 11 shows the details of the evaluation tool. An instructor can provide any information they deem essential for students before they begin completing tasks. This could include format requirements, such as font size or title page requirements. The instructor should also include evaluation criteria, a description of the task, steps (if applicable), a brief theory, or even a sample report if they think it would be beneficial.

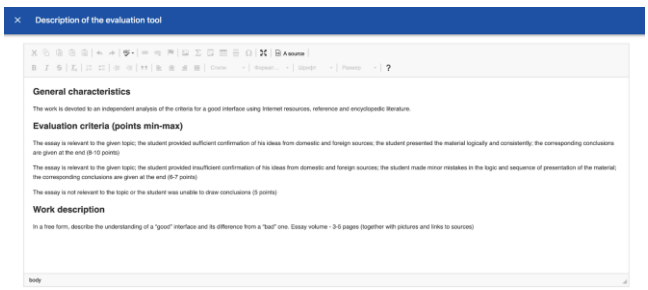


Fig. 11. Evaluation tool details.

The next step in the Educational Program Maker wizard is like the previous one. It outlines the evaluation tools for intermediate certification, typically a course final exam or pass-fail exam.

Instructors usually provide possible grades for the exam, the format of the exam, and a list of theoretical questions for the exam.

One of the final steps in creating the course syllabus is filling out learning outcomes (see Fig. 12).

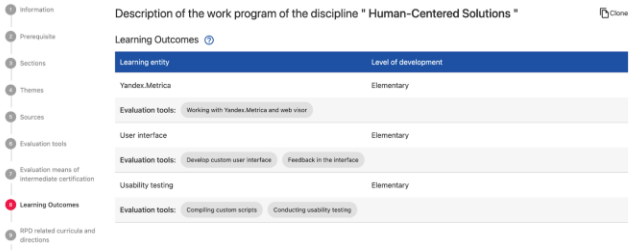


Fig. 12. Learning outcomes.

In Educational Program Maker, course prerequisites can also be used as learning outcomes. These entities may repeat prerequisites, but at higher proficiency levels or refer to other aspects of the subject area that students interacted with during the course.

As mentioned earlier, various automation and content recommendations were added to the course creation flow to make syllabus development easier for instructors. In papers [16, 17], the process of generating learning outcomes recommendations based on the course content was described. The implemented algorithm performs text analysis of literature sources and the course structure and proposes study entities that could be relevant.

The ninth wizard step displays related curricula and majors, providing a comprehensive view of the role of developed curricula in the study process.

The last wizard step allows us to describe specific competencies that students acquired during the course (Fig. 13). Examples of such competencies include: “Ability to use the system of worldview principles for self-realization, development of a life strategy, formation and development of views and beliefs” or “Ability to apply digital technologies to analyze and solve worldview, social, personal, and professional problems, and processes that determine life in the digital space.” Competencies typically refer to broader skills, rather than specific subject areas.

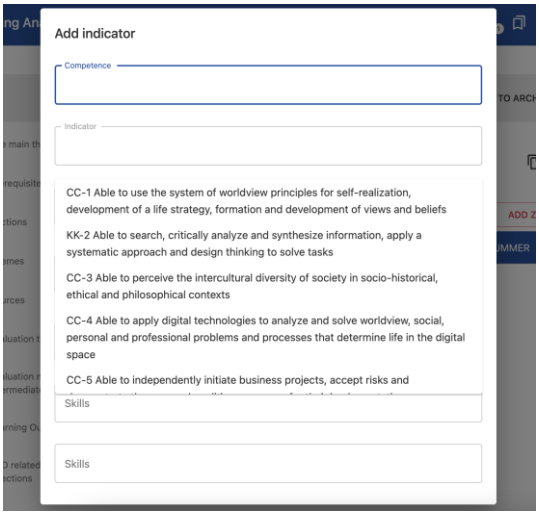


Fig. 13. Description of competencies acquired for the course.

After entering data in all these steps, syllabi are sent to experts for proofreading. The experts either approve them or return them to instructors for essential corrections.

V. Educational Program Maker Evaluation

Since the spring of 2021, the Educational Program Maker has been extensively employed at ITMO University for curriculum planning. Initially, it was piloted with a limited group of university staff members, but it has gradually evolved into an indispensable tool. In May 2022, adopting the Educational Program Maker as a compulsory platform for course development at ITMO University led to a notable increase in the number of courses, as demonstrated in the graph (Fig. 14). As of early 2023, over 5,000 training courses have been developed with the help of the Educational Program Maker.

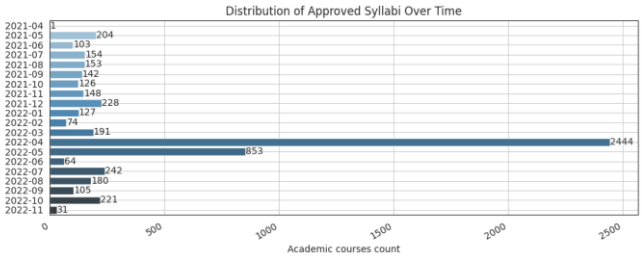


Fig. 14. Distribution of approved syllabi over time.

One of the indicators of the effectiveness of the Educational Program Maker is how fast academic courses receive expert approval. An expert typically approves a curriculum if it is free from errors in the subject area and meets educational standards. Such evaluation encompasses various aspects, including the appropriate allocation of hours between lectures and practical sessions, adequate assessment tools for students, a comprehensive description of the course structure, and the inclusion of recommended literature and other relevant requirements. If a course fails to meet these criteria, it is returned to the instructor for revision. The instructor is then responsible for addressing the expert's feedback and resubmitting the course for evaluation. The graph (Fig. 15) representing the average number of attempts to pass the course expertise per month provides insights into the revision process.

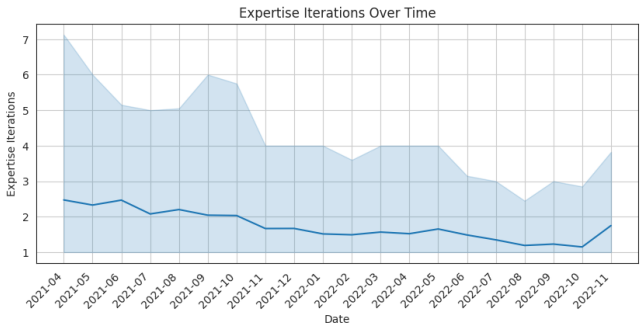


Fig. 15. Expertise iterations over time.

Fig. 15 shows that the frequency of revision rounds decreased steadily during the analyzed period. There are two main reasons for this change. Firstly, the Educational Program Maker has been enhanced with user-friendly interfaces that make the course development process faster. Secondly, instructors have become more familiar with and skilled in using the Educational Program Maker. A notable decline in expertise attempts is observed from October to November 2021. It can be attributed to the Educational Program Maker implementing automated checks for formatting requirements. Failure to meet these requirements will result in the inability to submit the course for expert review.

The expertise attempts graph displays apparent nonlinearity and cyclical patterns that arise from the seasonal fluctuations in course development. These patterns are a direct result of the increased workload experienced by course editors during the spring and fall semesters. It is important to note that these fluctuations contribute significantly to the observed patterns in the graph.

The successful completion of expertise requires approval from at least one expert. Additional experts are engaged in the evaluation process to ensure the prompt completion of course expertise during peak workload periods. Fig. 16 clearly shows that the number of experts involved reaches its highest point in December and May, indicating a recurring pattern. However, over time, there is a gradual decline in the number of individuals involved in the expertise process. This trend can be attributed to the improved user-friendliness of the Educational Program Maker interface and the accumulating expertise of the reviewers.

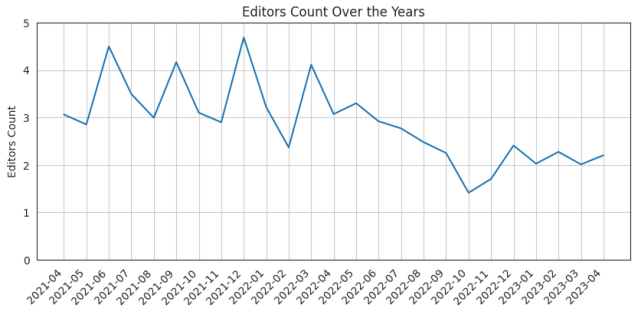


Fig. 16. Number of editors over time.

The authors aim to make the course revision process more efficient and quicker without involving more experts. Based on data analysis, implementing automated checks, providing instant feedback to instructors, and reducing the workload on reviewers have resulted in the most significant improvements in expertise speed.

VI. Discussion

Syllabus creation is a common feature of Educational Program Maker, but it is not the only one. The platform also allows users to create other electronic documents essential for the educational process, such as descriptions of student practices, final certifications, descriptions of online courses, curricula, and individual learning tracks.

Documents for student practices and final certifications are generally structured similarly to the syllabus but differ conceptually. These may include educational practices or work experience internships. Educational practices typically involve a few lecture hours and consultations with tutors, while work experience internships require students to detach from the university for a period of time and gain practical skills in the field. The documents for these internships and final certifications focus more on skills and competencies.

Individual learning tracks can be created manually by staff

members or students and validated to meet State educational standards [18]. The educational program graduate must demonstrate competencies according to a professional standard. Building an individual learning track independently may mean that students have not acquired all the necessary competencies outlined in the curriculum. Furthermore, an average student may not be able to construct a learning track that ensures the continuity of knowledge between courses. Therefore, provided validation is essential.

The second option for using individual learning tracks in the Educational Program Maker is to get curriculum recommendations based on the target profession [18]. To select an individual curriculum, the service client must choose a profession. Relevant data will be used to select the most suitable curriculum with a choice of optional courses and majors in real-time. There could be dozens or hundreds of possible learning tracks within a particular curriculum, considering the optional academic courses. In this case, a recommendation of an educational program or individual learning track is a ranked list of educational programs with optional courses customized to the user's career choice.

Thus, most electronic educational documents in one place give a better understanding of the role each academic discipline plays in the educational process and what skills the student will gain upon graduation. Using the same educational entities when creating different educational documents helps unify terminology and create more consistent relationships between entities. If curriculum creation was done in a text editor, this kind of unification would only be possible if instructors consistently named educational entities in a similar way.

Finally, Educational Program Maker ensures all curricula are organized in the same format, enabling them to be exported in the required form and integrated into other university services.

VII. Conclusion

The present study involved a comprehensive review of literature and the examination of past experiences, followed by a meticulous analysis of the structure of the educational curriculum. The implementation of the revised curriculum was successfully executed and incorporated into practical use. The Educational Program Maker was presented to university instructors and employees of the educational activities department. After active use since March 2021, a process satisfaction survey was conducted, which demonstrated a high level of user satisfaction with its intuitive and user-friendly interface. Users reported no problems finding the necessary functions in the interface when developing syllabi and sending them to expertise.

By the end of 2022, 995 professors and editors had created and verified 5,832 syllabi using the Educational Program Maker. This accounts for nearly 55% of all relevant syllabi to date. According to 87% of users, creating syllabi in the Educational Program Maker is much more convenient than using Microsoft Word or similar software. Users are also interested in the service's further development. The objective is to enhance the interface and add new features to Educational Program Maker to minimize the need for corrections. Feedback is frequently received from users of Educational Program Maker, and ideas are tested to enhance their experience.

Creating a syllabus can be a challenging task for university instructors, regardless of their level of experience. To simplify the process, Educational Program Maker offers explanations, hints, and recommendations throughout the curriculum development process. This approach helps reduce the workload of experienced instructors and provides extensive support for those who are less experienced. The aim is to ensure that every instructor using Educational Program Maker can navigate the interface effortlessly and successfully complete the course program on the first attempt, resulting in a passing examination.

Conflict of Interest

The authors declare no conflict of interest.

Author Contributions

M. Khlopotov proposed the methodology, while P. Shnaider and A. Chernysheva conducted a literature review. All authors participated in the design of the web service, implementation of the model, and writing of the paper. All authors had approved the final version.

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