

Methodological approach for developing online courses: a case study

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Abstract. Online courses are becoming more popular and accessible, but they require careful design and development of their structure and content. This paper presents a methodological approach for creating online courses by analysing existing practices and learner feedback. The paper focuses on the case study of the online course "Methods for Teaching Mathematics to Students in Technical Universities", developed and tested by the authors. The paper discusses the main aspects of online course development, such as weekly planning, testing subsystem, video and PDF content, forum and survey subsystems, and assessment of learning outcomes. The paper also evaluates the quality of the online course and identifies some areas for improvement. The paper concludes that online course quality depends on various factors and provides recommendations for online course developers.¹

Keywords: online courses, online learning, course design, course development, course evaluation

In memory of Iryna V. Sitak, a brilliant researcher and dear friend.

1. Introduction

1.1. Motivation and research question

Online education is a rapidly growing field that offers new opportunities and challenges for learners and educators. Online education can provide access, flexibility, and personalisation

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of learning, but it also requires careful design and development of online courses that meet the needs and expectations of diverse learners. Online courses are not simply a transfer of traditional courses to the online environment but rather a complex process involving various aspects, such as content creation, delivery, evaluation, and improvement. Therefore, online course developers need to follow some methodological guidelines and best practices to ensure the quality and effectiveness of their online courses. However, there needs to be more comprehensive and consistent methodological recommendations for online course development in the literature. Sources may offer different or contradictory suggestions for online course design and development.

Moreover, some sources may need to be updated or relevant to the current state of online education. Thus, there is a need for a systematic and updated methodological approach to online course development that can be applied to various disciplines and contexts. This paper addresses this need by presenting a methodological approach for developing online courses by analysing existing practices and learner feedback. The paper focuses on the case study of the online course “Methods for Teaching Mathematics to Students in Technical Universities”, developed and tested by the authors. The research question guiding this paper is: What are online course development’s main aspects and principles, and how can they be implemented in practice?

1.2. Literature review

Online course development is a complex and multifaceted process that requires careful consideration of various aspects, such as content creation, content delivery, content evaluation, and content improvement [38]. This paper adopts a methodological approach for online course development based on analysing existing practices and learner feedback. We review the relevant literature on online course development, focusing on the following topics: community building and collaboration, goal setting and planning, lecture materials and video content, testing and assessment, and web tools and resources.

Community building and collaboration are essential for online courses, as they foster a sense of belonging and engagement among learners and educators. FAO [12] suggests that online courses should encourage the creation of practitioners’ community and support their willingness to cooperate. This can be achieved by providing various opportunities for interaction, such as forums, chats, blogs, wikis, etc.

Goal setting and planning are essential for online courses, as they provide a clear direction and structure for learning. Vlasenko et al. [32] proposes a concept of the platform “Higher School Mathematics Teacher” [14], which is based on the idea of weekly planning and achievable goals. The authors argue that setting realistic and attainable goals can motivate learners to aspire to more and monitor their progress.

Lecture materials and video content are the primary sources of information and knowledge for online courses. They should be designed and developed in a way that is engaging, informative, and accessible for learners. Bauer [3], Deming et al. [9], Dommeyer et al. [10] describe their experience of improving lecture materials using surveys from learners who took their courses. They highlight the importance of feedback and evaluation for improving the quality of online courses. Cruse [7], Suduc et al. [26], Suduc, Bizoi and Filip [27] recommend using video lectures

as a powerful tool for online education. They claim that video lectures have several advantages over text-based lectures, such as allowing learners to learn at their own pace, providing emotional impact, and enhancing retention.

Testing and assessment are crucial for online courses, as they measure the learning outcomes and provide feedback to learners and educators. They should be aligned with the learning objectives and the content of the online courses. Suwatthipong, Thangkabutra and Lawthong [28] suggests that testing should serve both formative and summative purposes, that is, to help learners acquire new knowledge and to evaluate their achievement level. Testing can be implemented in various forms, such as quizzes, assignments, projects, etc.

Web tools and resources are additional elements that can enrich online courses and provide more learning opportunities. They can include various media types, such as images, audio, animations, etc., and external links to other websites or platforms that offer relevant information or services. Jönsson [15], Vlasenko et al. [37] justify the efficiency of integrating various web tools and resources in online courses. They argue that web tools and resources can enhance the learning experience by providing more diversity, interactivity, and personalisation.

In summary, the literature review shows that online course development is a dynamic and iterative process that involves multiple aspects and principles. The paper aims to synthesise these aspects and principles into a coherent methodological approach for online course development that can be applied to various disciplines and contexts. The paper focuses on the case study of the online course “Methods for Teaching Mathematics to Students in Technical Universities” [14], developed and tested by the authors using this methodological approach.

2. Method

The analysis of the content on open educational platforms, the world experience of implementing online learning, the synthesis of the results after such an analysis, and our own experience allowed us to form methodological recommendations for preparing online courses.

We have surveyed master students (the qualification code of the program “014.04. Secondary Education. Mathematics”) and higher school mathematics teachers to find out the quality of educational materials for the online course “Methods for Teaching Mathematics to Students in Technical Universities”, published on the platform “Higher School Mathematics Teacher” [18]. The theoretical analysis of the research and resources that implement the recommendations, content structuring and development of online courses, and analysis of respondents’ answers to the survey questions published on the platform forum have influenced the description of the methodical recommendations for the structure and content of online courses. We analysed the structure and content of the most popular Massive Open Online Courses (MOOC) to explore the resources. When selecting resources, we focused on the online courses [6, 11, 13, 17, 29] included in the Top Tools for Learning [5].

Having analysed the resources, we found several sections that include online courses and the average course duration. We were eager to know how often titles are offered and the purpose of testing in courses. We have highlighted the peculiarities of video lectures and training materials in PDF format. Particular attention was paid to the organisation of the course process and feedback from students. Through content analysis, we have developed methodological

recommendations for developing the structure and content of online courses on the platform “Higher School Mathematics Teacher” [14].

2.1. The presentation of the course taking into account the peculiarities of an online presentation

At the beginning of education on open online platforms, the user should clearly understand how they will learn and what material they will work with.

Following the recommendations of dividing online course content into sections, subsections (topics), pages, and components [34], we concluded that the construction of an online course should be based on weekly planning, where sections are formed on the principle of combining materials that are learned during one or several weeks.

We have also considered that educational methodical online courses must include at most six sections. Every section has to include one or more pages; the page has no more than one component. For instance, the online course “Methods for Teaching Mathematics to Students in Technical Universities”, published on the platform “Higher School Mathematics Teacher” [18], includes three sections with three topics for each one. At the same time, the course “Project Method in Teaching Higher Mathematics” [16] includes six sections with two topics for each (figure 1), and the course “Personal E-learning Environment of the Maths Teacher” [35] has five sections with two topics for each (figure 2).

The number of sections and topics depends on the course volume and the preliminary survey of teachers and students (course users) who help to determine the course structure.

2.2. Structuring

Before creating the course, it is necessary to have a clear understanding of the course’s target audience, primary needs, and peculiarities of this audience. So, tutors must determine the aims of learning and anticipated results, subject, structure, assessment criteria, and feedback organisation. It significantly influences the content and structure of the course. Moreover, it is necessary to consider when and how the course users will learn. Also, how often it is needed to update the learning material and how much time the tutor will spend on the organisation of education and feedback should be considered. If there has to be a significant number of users, it is necessary to think about automating these processes.

The course structure should be logical, clear, and intuitively understandable. While creating the course, the following points should be considered:

- 1) the learning material of the course has to be divided into logical sections, or according to the topics (figure 3), or of a particular length to learn it during 1-2 hours (typical learning class);
- 2) the headings of sections, topics, and subtopics should be well formulated; it will help users to plan which sections they will work over at every class and will allow them to skip topics that they already know;
- 3) before providing the material for every new topic or section, it is necessary to give a review of the coming material, its structure, results of learning, and approximate time of learning; it is relevant to give such material in the form of a short video;

COURSE PMTHM	
Home > Courses > Instruction and methodology trainings > Project method in teaching higher mathematics > Course PMTHM	
- 📅 Course content	
Week 1	
1st unit.	History of the project method
2nd unit.	Definition of the project. The essential difference between the concepts
Week 2	
3rd unit.	Project method, Problem method, Inquiry method. Common and differences
4th unit.	Case Technology and STEM Technology
Week 3	
5th unit.	Context and project methods
6th unit.	Types of projects
Week 4	
7th unit.	Experience in using the project method in higher mathematics teaching
8th unit.	Curriculum in Higher Mathematics and Projects

Figure 1: Structure of the course “Project Method in Teaching Higher Mathematics”.

- 4) pretesting or final testing after learning a particular topic or section can be conducted on request.

The first three recommendations were considered while developing all the platform courses [14]. The online course “Methods for Teaching Mathematics to Students in Technical Universities” [18] includes both the pretesting on Higher Mathematics and the final course testing. Pretesting is included in the course as it is impossible to succeed during the test without learning the corresponding sections of Higher Mathematics.

2.3. Features of writing

The educational materials should be taught in an accessible and clear form. Considering the peculiarities of perceiving the electronic information [16], the material posted in the electronic format should be 50%

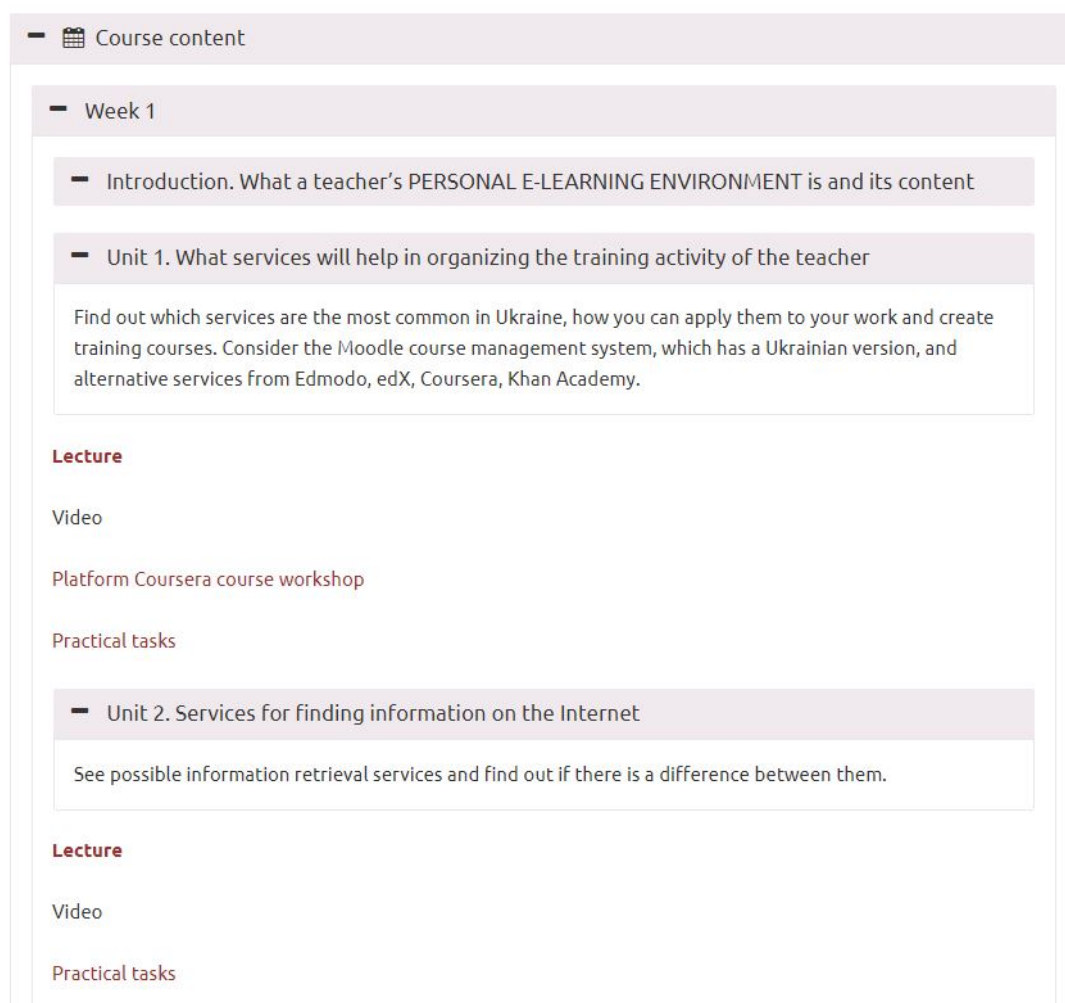


Figure 2: Structure of the course “Personal E-learning Environment of the Maths Teacher”.

Besides, it is necessary to explain every new definition or term. It can be a context tooltip, footnote, hyperlink, etc. Also, creating a separate glossary for every section or topic is relevant.

To give the primary theoretical information on the topics during the online course, we use educational materials in PDF format that ensure compatibility and the absence of distortions in published course materials. Moreover, PDF format allows the participants to download educational materials to their proper computers for further acquaintance without any preview on the web page [22].

While creating educational materials in PDF format, it is necessary to follow the requirements for presenting documents: to use headings, lists, and images with signs and to represent table data in tables. The direct (regular) font, which ensures a more straightforward perception of information, should mainly be used to type text material. The main text should be aligned to the page width. It is not recommended to use formatting with the help of indent and tabulation,

COURSE MTMSTU

Home > Courses > Instruction and methodology trainings > Methods for teaching mathematics to students in technical universities > Course MTMSTU

Curriculum

Introduction. Presentation of training courses

Week one

Topic 1.1. Didactic basis Master's programme in preparation for assistant practice: method of studying mathematical concepts.

Topic 1.2. The basic content of the course Mathematics for students of HTS: elements of linear and vector algebra.

Topic 1.3. Learning technologies of Math tutoring: usage of SCM.

Week two

Topic 2.1. Didactic basis Master's programme in preparation for assistant practice: lecture on mathematics.

Topic 2.2. The basic content of the course "Mathematics" for students of HTS: elements of analytical geometry.

Topic 2.3. Learning technologies of Math tutoring: project methods.

Week three

Topic 3.1. Didactic basis Master's programme in preparation for assistant practice: tutorials in mathematics.

Topic 3.2. The basic content of the course "Mathematics" for students of HTS: elements of mathematical analysis.

Topic 3.3. Learning technologies of Math tutoring: cloud computing.

Introduction

Move on to the course

Figure 3: Sections of the course "Methods for Teaching Mathematics to Students in Technical Universities".

multi-column page making, or blank lines. While using hyperlinks, it is necessary to consider that all hyperlinks should be represented as text in the sentence to increase readability.

For instance, the course "Differential Equations" [25] widely uses hyperlinks and popup notes (figure 4), while the course "Operations Research-Oriented to Cloud Computing in the System CoCalc" [4] offers smaller documents in PDF-format that can be downloaded by students for further use.

2.4. Bright presentation of material

To attract attention to online courses and support students' interest it is relevant to use all the possible means of material delivery – animation, video, multicoloured unusual fonts, footnotes, and popup tooltips. The relevance of using the side framework to add information is proven.

Suppose it is necessary to publish educational material directly on the online course page. In that case, it should be "divided" into parts following the screen size, the navigation and hyperlink system should be organised, and an additional PDF version to store and print the learning material should be created.

Test 3.1.2

Question 2 to 5

From the given systems of differential equations, choose the ones that belong to the normal ones.

$$\begin{cases} \frac{dy_1}{dx} = y_1 + 2y_2, \\ \frac{dy_2}{dx} = 3y_1 - y_2. \end{cases}$$
$$\begin{cases} t dx + (x - t \sin t) dt = x, \\ dx + dt = 0. \end{cases}$$
$$y_1'' - 8y_1' + 16y_1 = e^{4x},$$

Hint
From the given systems of differential equations, choose the ones that belong to the normal ones.

Hint **Verify**

Figure 4: Popup notes in the course “Differential Equations”.


The necessity of doing group tasks to analyse and assess other course participants’ work adds to the users’ interest. It will encourage the regular analysis of the learning material and periodical review. While giving the material, repeating the key concepts, ideas, and theories several times in different forms (if possible) is relevant.

According to the recommendations, materials of the online courses “Project Method in Teaching Higher Mathematics” [33], “Personal E-learning Environment of the Maths Teacher” [30], “Methods for Teaching Mathematics to Students in Technical Universities” [18], published on the platform “Higher School Mathematics Teacher” [14] are given using video files, hypertext, demonstrative animation, audio lectures, video lectures, schemes, images, graphics, tables, drawings, information reference material (figure 5). Also, presentations and other extra materials, such as attached files, interactive supplements, and sources in the reference list, are used.


We use video content to get participants acquainted with the aims and resources of the course, as well as highlight particular topics. Video lectures focus on the central moments of learning material, disclose the topic of the material, and summarise the main conclusions. While

9th unit. Mini-projects as an effective way of preparing students to complete a project in higher mathematics

Concepts and facts
Supporting abstract
 Video



Seminar



Do practice

Figure 5: Online course “Project Method in Teaching Higher Mathematics”.

creating video lectures it is expected to highlight semantic blocks (video clips) lasting from 3 to 10 minutes that the participants will watch during the online course. The image should be high-quality, and the text demonstrated on the slides should be available for reading from the mobile device screen. Pure sound requires minimal background noise, clear pronunciation of words, and a stable volume level. While creating video lectures, using the universal format of video files, MP4 is preferable.

To create videos during the online course “Methods for Teaching Mathematics to Students in Technical Universities” [18], we used the software Camtasia, which implements capturing the video from the screen. Among the main functional abilities of this video editor, which is used while developing educational videos, we can highlight providing the recording of the image

from the screen, including recording sound effects from the microphone or speakers and editing a new video without installing additional software.

To publish video content on the online course pages, we used the video from the file directly on the administrator's panel of the electronic platform without involving extra services. Using such a method of integration ensures the possibility of controlling the video player's size and adding extra settings.

2.5. Organisation of the learning outcome assessment

While developing the course special attention is paid to the creation of a system to assess the learning results. It can be a constant assessment, such as tests and/or completing control tasks with saved results (such a system encourages constant interest in course completion). Using the final test on the formed competencies, such as certified testing or qualified work, is possible. Let us mention that such an assessment method requires special students' motivation for test completion.

The course developer has to indicate how much time they need to check the tasks, if they were given, when, and how the student can get a certificate or another learning result.

For example, in order to implement the testing subsystem on the platform "Higher School Mathematics Teacher" [14], a program application for extending functionality was used – the plugin "WP-Pro-Quiz" that ensures flexible settings of the responses options and provides related information.

While creating test questions, it is stipulated that information about the number of points for the correct answer is provided, and the type of answer (single-choice, multiple-choice, open-choice, etc.) is indicated. Also, there is a possibility to add hints to a particular question. After creating and setting up the test, it is possible to publish it on any online course page using unique shortcodes.

For instance, for the online course "Differential Equations" [25], the test is considered passed if the participant gives 60% of the correct answers. After the test, the participant can look through the number of correct answers and the time spent on taking it.

A vital element while developing an online course is using surveys that enable the teacher to ask participants questions and offer a wide range of possible answers. While creating a survey, the teacher describes a specific situation and formulates a question to encourage participants to express their opinions. The final result of the survey is the percentage of the participants who chose one or another response.

During the course "Methods for teaching mathematics to students in technical universities" [18], "Personal E-learning Environment of the Maths Teacher" [35], "Creative Thinking Through Learning Elementary Maths" [1], etc. surveys are created with the help of the service Google Forms and are used as voting for theme selection as well as for discussion over course materials (figure 6, figure 7).

The following characteristics explain the choice of Google Forms as a tool for creating surveys: availability of the created survey for the respondents just after its publication, the possibility to edit it, opening for getting answers, and closing after finishing the survey. Furthermore, it is possible to integrate survey forms on the online course page. In order to show the survey results, the service automatically generates an electronic table; there is an option to review respondents'

Questionnaire for undergraduates who major in Mathematics

Dear Masters, we invite you to take part in a questionnaire on how to improve your professional training. We offer you to join the discussion of the content of the course «Methodology of Mathematics Education at Higher Technical Educational Institutions».

* Обязательно

Surname and name of the respondent *

Мой ответ

3. Do you think that your training is sufficient for teaching mathematical disciplines at Higher Technical Educational Institutions? *

Yes, I have enough knowledge about mathematical disciplines and pedagogy and psychology

Not sure, because I did not study special courses of teaching at Higher Technical Educational Institutions

I have some specialist knowledge but I am in doubt about my training to teach mathematical disciplines at Higher Technical Educational Institutions

No, because I do not know the methods of teaching disciplines at Higher Technical Educational Institutions

4. I have a desire for increasing the level of methodical preparation for work at Higher Technical Educational Institutions *

I collect different information

Figure 6: Online course “Methods for teaching mathematics to students in technical universities”.

answers in the form of diagrams and graphics with statistical information in high-quality and percentage format.

In the course “Differential equations” [25], we use the system of tests with the educational aim, not the knowledge control aim. Students can pass tests several times and get instructions

Creative (for students)

Dear students.
Please answer the questionnaire about creativity and the role of mathematical problems in its formation.

* **Обязательно**

1. What is creative thinking, in your opinion? *

Мой ответ

2. What are the key characteristics of creative thinking? (no more than four can be selected): *

- ability to identify and pose a problem;
- ability to divide a problem into components (subproblems);
- the ability to generate a large number of ideas;
- flexibility - the ability to produce different ideas;
- originality - the ability to respond outside the box;
- ability to improve the subject, add details;
- ability to solve problems.

3. Arrange the criteria for the systematic ordering of elementary mathematics problems by the importance in your preparation for future professional activity: *

	1	2	3
at the request of the task	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Figure 7: Online course “Creative Thinking Through Learning Elementary Maths”.

for the correct answer. Within the course “Methods for Teaching Mathematics to Students in Technical Universities” [18], we assume to have peer assessment to estimate the performance of training activities. While using this type of evaluation, we followed the recommendations for developing the criteria table. We considered the requirements for tasks to be clearly defined and

encouraged the author (later reviewer) to pay attention to different sides of the work. Writing a piece of work that corresponds to the requirements and checking such works is helpful for participants, as it develops skills of giving constructive criticism including negative.

For every task, the course tutor developed the evaluation criteria with a detailed description of the necessary content on every criterion to get a particular mark. As a tool, we offer to use Google Drive services to complete the task; it ensures the possibility of storing completed works by implementing shared access to the documents and Google Forms to implement the feedback with participants.

Successful learning of the educational material of the course is completed by getting a certificate. The criteria for getting a certificate are based on a criteria-oriented approach that includes comparing the educational achievements of every participant with planned learning outcomes.

2.6. Feedback organization

The feedback organisation is important both for the course developers and course participants. The necessity to ask questions and receive responses, discuss the issue, and express recommendations for the course arises during any education.

The feedback can be organised separately for every course and online platform. It can be a discussion page, chat, or forum. Organising the prompt course tutors' notifications about new questions and messages is crucial. Usually, it is necessary to indicate them in the corresponding page/forum settings. Such an option allows for reacting promptly to incoming messages.


For example, during the course "Methods for Teaching Mathematics to Students in Technical Universities" [18], "Personal E-learning Environment of the Maths Teacher" [35], "Operations Research-Oriented to Cloud Computing in the System CoCalc" [31], the feedback with course participants is organised using thematic forums (figure 8). Participants' part in the weekly forum allows them to express their proper opinions using discussion questions that concern the course's main topics.

Together with the forum, the organisation of participants' communication occurs in asynchronous mode, in other words, during a long period. Participants can sign up for the forum to get notifications about new topics and answers on the forum. With the help of the forum, there is a participants' discussion of their classmates' works, which is outlined by one of the course tasks. Furthermore, participants can use the forum to share examples of their work and to ask each other questions and the teacher about the topics they studied.

The forum implementation on the platform "Higher School Mathematics Teacher" [14] was carried out using the plugin "wpForo", which consists of a set of the main tools for managing the forum. The main advantages of using the plugin are flexible settings of the forum presentation, the creation of a convenient user profile, and the possibility to add particular supplements to extend the functionality.

Besides the forum, teamwork with shared documents and emails is used to organise feedback during all the courses.

Forum of the week 2

[Subscribe for new topics](#) | [RSS](#) 

[Add topic](#)




Topic Title	Posts	Views	Last Post
 <p>What kind of teacher activity did you find the most difficult this week?</p> <p><small>Sergei, 1 year ago</small></p>	8	240	By Sergei > 1 year ago
 <p>Justify your own suggestions for using the project method in teaching the topic "Elements of analytical geometry".</p> <p><small>Sergei, 1 year ago</small></p>	6	234	By Sergei > 1 year ago
 <p>Did you have any questions or difficulties in choosing a system of exercises for a practical lesson on your chosen topic of analytical geometry?</p> <p><small>Sergei, 1 year ago</small></p>	7	206	By Sergei > 1 year ago

Figure 8: Thematic forum in the course “Methods for Teaching Mathematics to Students in Technical Universities”.

2.7. Editing and checking

It is important to remember that any material the course developers give students reflects the scientist’s qualities or the educational institution that owns the corresponding open educational platform. Thus, all distance education materials must be checked in advance. It is relevant to carry out the approbation of the educational course as a pilot project with discussions on the teachers’ forum and further consideration of remarks and recommendations. Also, an outside review of educational materials by several users with different levels of training can be used. Reviewers must be developers’ colleagues, specialists of the corresponding area, linguists, and non-trained specialists.

Before publishing the materials, printing them and rechecking them is necessary. Particular attention should be paid to the observance of copyright; it is important to ensure all the borrowed materials have authors and references.

It is essential to develop the course not only in the official language but also in English so that it significantly increases the audience of the educational platform.

2.8. Responsiveness

Most users study the course using their phones or tablets. Therefore, it is vital to remember this fact during course development. Responsiveness reflects the quality and aesthetics of the system display on mobile devices with different resolutions. To ensure the responsiveness of the course design, it is advisable to use methods of presenting the interface using CSS stylisation for individual device resolutions.

Remembering that the menu interface and sidebar elements look different on different mobile devices is crucial. To better understand the course, the developers must adapt the text size, headings and subheadings, links, buttons, image sizes, and other interface elements. Thus, in

figures 9 and 10, we can compare the look of the course page “Personal E-learning Environment of the Maths Teacher” on a desktop computer and a smartphone.

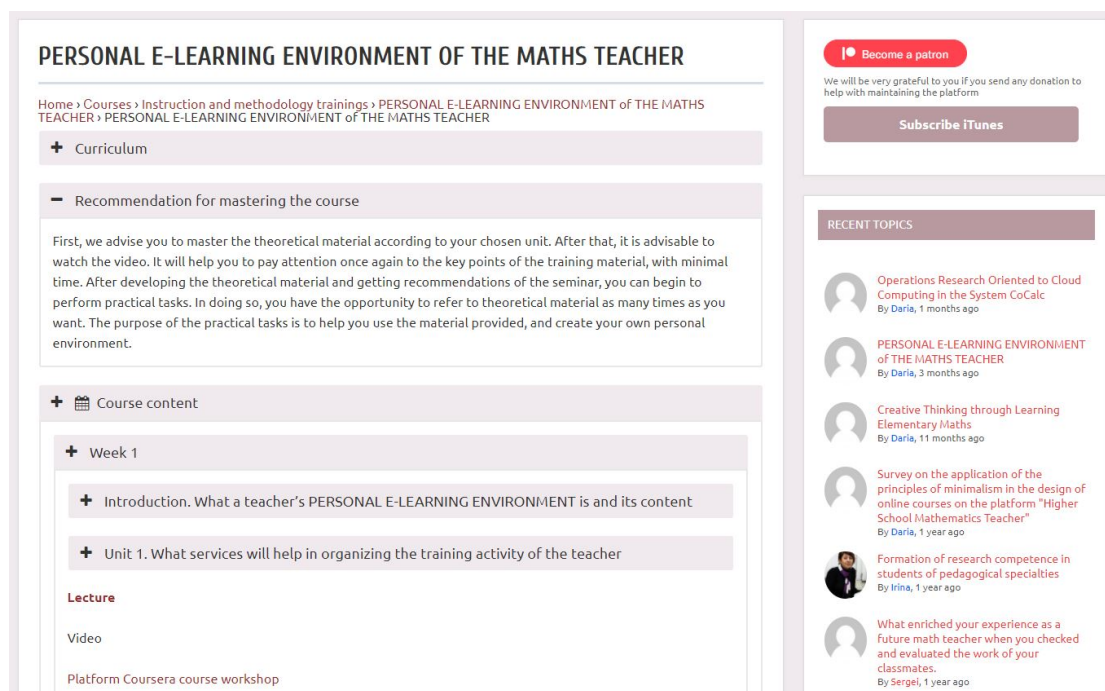


Figure 9: Desktop version of the course “Personal E-learning Environment of the Maths Teacher”.

3. Results

To analyse the correspondence level of the content during the course “Methods for Teaching Mathematics to Students in Technical Universities” [18] to specified recommendations for developing online courses, we held a survey among the participants. Respondents were offered to answer the survey questions using the forum on the platform “Higher School Mathematics Teacher” [14].

Sixty-eight volunteers who agreed to test the educational materials of the course took part in the survey. Participants’ answers allowed for evaluating the quality of the developed course and determining minor gaps in the implementation.

We asked them to rate the quality of presenting information concerning the structure and semantic content of the online course on a scale from 1 to 5, where 1 is the minimal parameter estimate, and 5 is the maximal one. Table 1 provides the survey results.

The ranking results are a histogram (figure 11).

Analysing the histogram data, we concluded that most volunteers have highly evaluated the structure and quality of the developed content of online courses, giving 4 or 5 points. In the respondents’ opinion, presenting information concerning the course program, its duration, and the frequency of classes was fulfilled most successfully. Among the types of educational content,

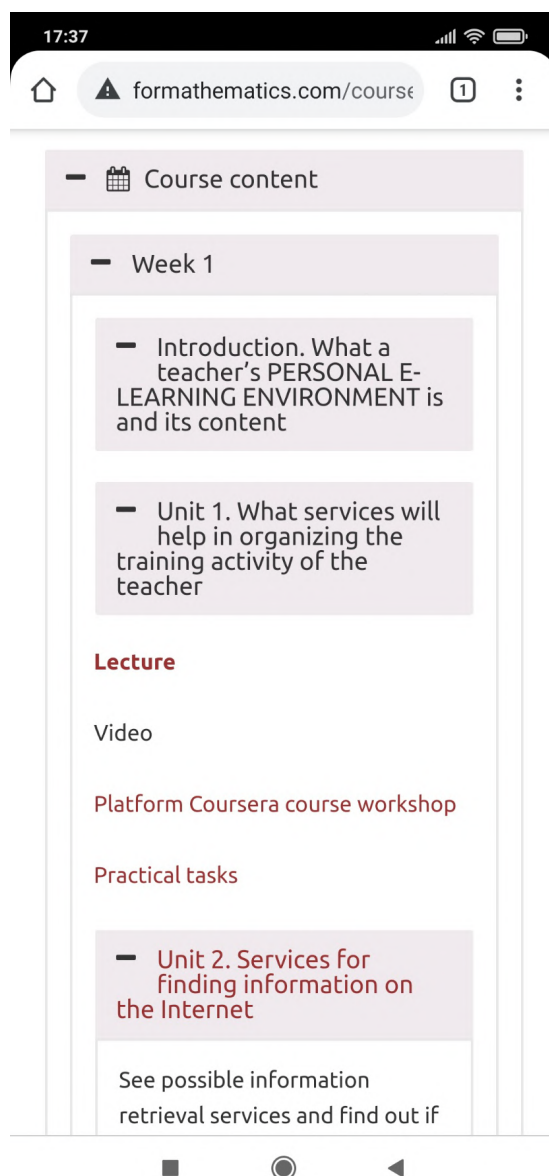


Figure 10: Mobile version of the course “Personal E-learning Environment of the Maths Teacher”.

educational content in PDF format and video lectures got the biggest number of maximal points. So, the presentation of the online course structure and the quality of the developed educational materials correspond to the given recommendations.

Moreover, participants were offered to evaluate the general impression from the online course “Methods for Teaching Mathematics to Students in Technical Universities” [18] (figure 12).

According to the survey results, 68%

Table 1

Results of testing educational materials of the course “Methods for Teaching Mathematics to Students in Technical Universities”.

Questions	Respondents' answers				
	1	2	3	4	5
Accessibility of information presentation concerning the aims and purposes of the course	5	8	10	27	18
Accessibility of information presentation concerning the duration and frequency of the course	3	4	13	23	25
Accessibility of information presentation concerning the target audience of the course	6	3	11	28	20
Accessibility of information presentation concerning the course program	1	6	9	25	27
Convenience of the navigation system during the course	8	9	15	24	12
Quality of presenting educational materials as video lectures	1	4	7	29	27
Quality of presenting educational materials in PDF format	2	6	12	23	25
Quality of tests	3	5	14	26	20
Quality of survey implementation among course participants	4	7	16	21	20
Quality of peer-assessment implementation	4	8	14	20	22
Quality of feedback implementation using the weekly forum	5	8	18	19	18

4. Discussion

The analysis of the research by Cuesta [8], McGahan, Jackson and Premer [20] and work experience of APass Educational Group, LLC [2] developing online courses have confirmed our point of view about the influence of the quality of developing materials for online courses on motivation and success during the course. We agree with the point of view given by Cuesta [8], who emphasises the necessity of constant analysis and evaluation of such parameters as forming learning content interaction among course participants. We support the conclusions given by McGahan, Jackson and Premer [20] about the importance of developing methodical requirements for the content of online courses as the primary tool of its quality evaluation. The recommendations provided by the APass Educational Group, LLC [2] are significant for our research; they offer to provide the efficiency of the educational aim of the course using the following means: clear purpose presentation; correspondence of the aim to the students' expectations; direct responsibility between educational aims and students' actions during the course and their evaluation; learning materials selection and technologies that correspond to the educational aims, student's motivation and support of their progress; content accessibility for all the students.

We got acquainted with the accomplishments of Morrison [21], Puziferro and Shelton [23], Scagnoli, Choo and Tian [24] when we started developing video lectures. These works are dedicated to researching students' opinions on video lectures in online classes. So, during the development of video lectures, we were focused on the scientists' recommendations. These recommendations were the following: to consider students' needs; to plan thoroughly and inte-

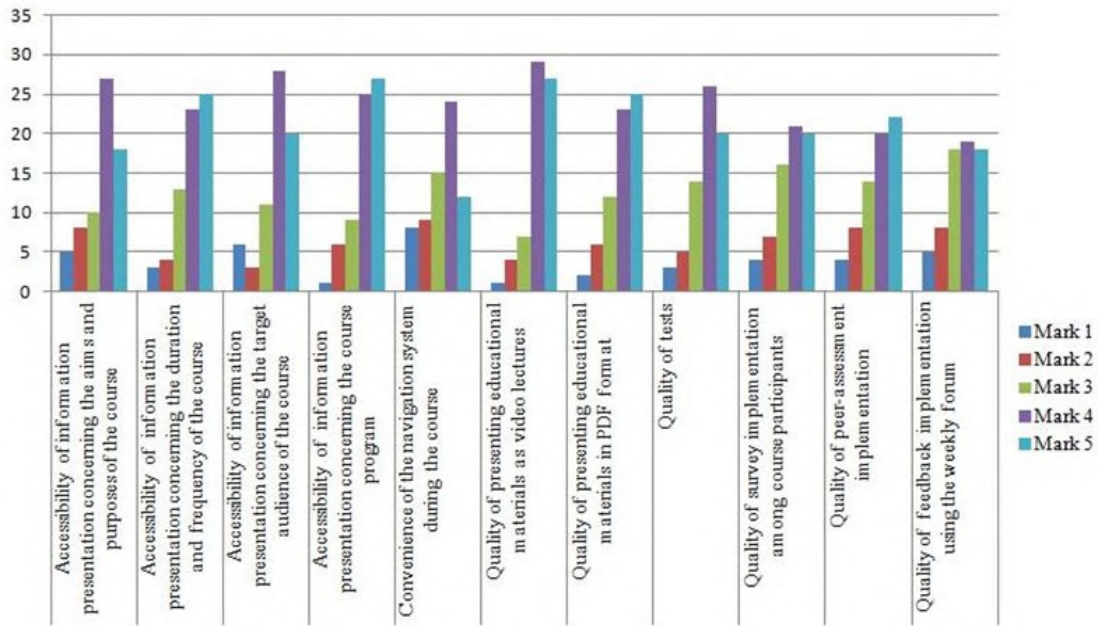


Figure 11: Results of testing educational materials of the course “Methods for Teaching Mathematics to Students in Technical Universities”.

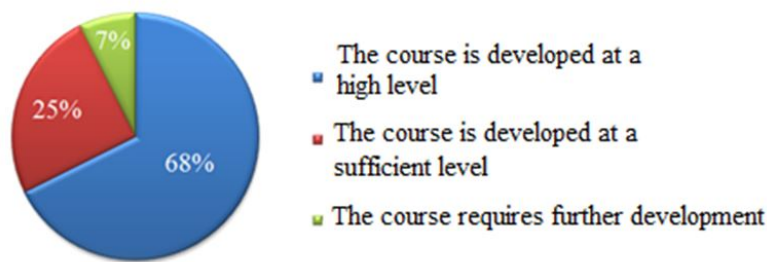


Figure 12: The general impression from the online course “Methods for Teaching Mathematics to Students in Technical Universities”.

grate a balanced way video lectures with other course materials; to use multimodal information delivery; to create a sense of cooperation with the content through students’ control over the media and teachers’ presence.

The acquaintance with students’ evaluation via Camtasia [39] as one of the most available programs for editing and creating videos has proved the relevance of the choice of this program for presenting course content. Screen recording with necessary effects helped us to create a high-quality new presentation and documents in PDF format. The forum participants approved the involvement of such a type of material. We encourage students to participate actively in forums during the course presentation and every week. This approach corresponds to the conclusions given by Martín-Blas and Serrano-Fernández [19], who prove that participants who

take an active part in forum discussions tend to get higher marks and show a higher level of learning educational material in comparison to those who did not use the forum.

5. Conclusions

Online course development is a challenging and rewarding process that requires careful design and evaluation of the structure and content of online courses. Online courses should be engaging, relevant, and motivating for learners, providing them with various opportunities for learning, interaction, and feedback. Online course content should be planned and integrated with other course elements, such as testing, video, PDF, forum, and survey subsystems. Online course testing should serve both formative and summative purposes and align with the learning objectives and the content of the online courses. Online course feedback should be collected and analysed from both learners and teachers to improve the quality and effectiveness of the online courses.

This paper presents a methodological approach for developing online courses based on analysing existing practices and learner feedback. We have applied this methodological approach to the case study of the online course “Methods for Teaching Mathematics to Students in Technical Universities”, developed and tested by the authors. We have discussed the main aspects and principles of online course development, such as weekly planning, testing subsystem, video and PDF content, forum and survey subsystems, and assessment of learning outcomes. We have also evaluated the quality of the online course and identified some areas for improvement.

The paper contributes to online education by providing a systematic and updated methodological approach for online course development that can be applied to various disciplines and contexts. The paper also offers some practical insights and recommendations for online course developers based on the case study of the online course “Methods for Teaching Mathematics to Students in Technical Universities”.

The paper suggests some directions for future research, such as exploring the usability and accessibility of online courses, investigating the impact of online courses on learners’ outcomes and satisfaction, and comparing different platforms and tools for online course development.

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