






# Advanced Technological Solutions to Support Distance Learning via Open-Source H5P Interactive Tools

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**Keywords:** Distance Learning Tools, H5P, Interactive Content, Active Learning, Higher Education.


**Abstract:** The widespread introduction of distance learning in the conditions of quarantine restrictions caused by COVID-19 increases the need to modernize the resource-and-organizational as well as methodological support of the educational process. The materials of the present paper embrace the study of the possibilities of using open-source H5P tools to support distance learning in higher education institutions. The authors analyzed the state of research of the problem of development and introduction of interactive didactic H5P tools in higher education institutions and identified insufficient use of this tool in higher education institutions of Ukraine despite successful foreign practices in place. Based on the results of the comparative analysis of the functionality of various means to support distance learning, which have become most common in higher education institutions, they defined the benefits of using H5P to maximize the involvement of students in distance learning and demonstrated the wider possibilities of creation, use and distribution of interactive educational elements on the basis of H5P in comparison with other technologies. The paper presents the results of a questionnaire conducted among the academic staff of the National University of Life and Environmental Sciences of Ukraine and Wrocław University of Environmental and Life Sciences on determining the complexity of development and pedagogical feasibility of using various H5P tools to support distance learning. Based on the analysis of academic staff's needs, they determined the necessity for specialized training on pedagogical design of the content of H5P didactic materials, delivery technologies and methods of their use in teaching various disciplines of higher education.


## 1 INTRODUCTION


As new information technologies and digital tools are developed and disseminated, technologies for the development, delivery and use of educational content are being enriched to ensure the quality of e-learning, taking into account: students' learning styles and age characteristics (Umryk, 2013), the available resources and competence of the subjects of the educational process (Kuzminska et al., 2019). However, during the mass transition to distance learning (Stauffer, 2020) in the conditions of COVID-19


(Miller, 2022), the problem of providing quality education is relevant, which, in our opinion, requires the training of specialists who will be able not only to use ICT in educational activities, but also acquire competences in e-learning management (Morze et al., 2017). Analysis of the attitude of teachers and students to the opportunities and problems associated with the introduction of distance learning (El Refae et al., 2021) is the basis for the assumption of actualizing the need to develop interactive teaching materials and educational content as a means of ensuring quality student-centered education (Homanová and Havlásková, 2019). The creation of interactive didactic materials and methods of their use in the educational process will contribute to the involvement of students in active learning: students can create resources independently or "interact" with the teacher to increase motivation, better understanding of learn-

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ing material, practical skills, evaluation of their own learning activities, etc.

From a technical point of view, the use of tools to create interactive didactic materials was limited by the need for computer programming skills. However, with the development of H5P technology, an open-source Internet tool, the creation of such materials does not require special training.

Therefore, **the purpose of this study** is to identify the potential of H5P to support distance learning in higher education institutions and to analyze the teachers' needs as for its application in educational practice.

## 2 THEORETICAL BACKGROUND

H5P (<https://h5p.org/>) is a module with a library of learning resources developed in HTML5, which is integrated for direct use in publishing systems (namely: Wordpress, Drupal) and learning management systems (such as Canvas, Moodle or Blackboard). The latter allows you to create interactive learning elements (development can be done by both teachers and students, for example, when doing independent work), which can be used at different stages of e-learning to form both general and subject competences of students.

The conducted analysis of research and publications on the use of H5P service in education is the basis for expressing an assumption about the effectiveness of the use of this service in the process of training specialists regardless of the educational program and specialty.

Santos et al. (Santos et al., 2019) represent the method of using the H5P service as a tool for gamification of practical skills (students' laboratory work) on local network administration, which provides a fast, intuitive and attractive for students method of applying the Flip-Game Engineering and Technology methodology (Flip-GET), developed by researchers at the University of Cadiz.

Methodology and practical cases of H5P application in the process of learning English in higher education institutions in Japan and Indonesia are presented in (Wicaksono et al., 2021). The experience of using H5P didactic materials in the study of chemistry (Zeller et al., 2021) is an example of the transformation of video into an interactive educational resource. The results of a study of the use of H5P in the training of future specialists in biological sciences (Manacek et al., 2020) indicate that this platform is an effective and universal tool for forming students' critical thinking, independence and confidence in mastering edu-

cational material in problem-oriented learning. Methodical recommendations for creating an interactive H5P video for the implementation of personalized and active learning are given in (Singleton and Charlton, 2019; Thurner et al., 2022). The experience of using H5P tools for the implementation of blended learning (Sinnayah et al., 2021) and development flipped classroom framework (Wehling et al., 2021) based on learning management systems highlights the need for additional research on the application of these tools in the educational practice of Ukrainian higher education institutions.

### Research tasks:

1. To investigate the functionality of H5P for the feasibility of using the H5P service to create and distribute interactive content.
2. To analyze the needs and readiness of the academic staff of the National University of Life and Environmental Sciences of Ukraine (NULES) and Wrocław University of Environmental and Life Sciences (WUELS) to create and use interactive didactic H5P materials in the educational process.

To achieve the goal and objectives of the study, the following methods were used: analysis of theoretical sources, study of successful H5P practices in the educational process of higher education institutions; generalization and systematization of experience in the use of e-learning support tools; empirical methods, in particular, questionnaires and monitoring of the educational process in higher education institutions during the implementation of distance learning during the COVID-19 quarantine restrictions.

## 3 MAIN FINDINGS

H5P is an open tool for creating, distributing and reusing educational interactive content, based on HTML5, CSS and JavaScript technologies, which does not require additional software for its work, therefore will work in all modern browsers, operating systems and devices.

Since H5P technology is integrated into a number of learning management engine drivers, such as Moodle, Canvas, Blackboard, Brightspace, and a variety of web content management systems, such as Wordpress and Drupal, integration into the higher education environment does not require additional costs at the technological level (environmental administration) and organizational – teachers can create educational content in a convenient for them environment with the ability to save and reuse. Figure 1 shows an example of creating and demonstrating the “interac-

Table 1: Comparative analysis of H5P, Moodle and Google Workspace functionality (not all the available H5P functionality is considered).

Purpose	Program	Module	Features
Folding text blocks (“accordion”)	H5P	Accordion	Ability to create a hidden (folded) text block with image formatting, etc.
	Moodle	Absent	Implementation using HTML, CSS or Bootstrap classes
	GWorkspace	Absent	
Interchangeable pictures swapping	H5P	Agamotto	Using simulation of dynamic change in time on the map, in space, zooming out/zooming in
	Moodle	Absent	
	GWorkspace	Absent	
Recording audio messages	H5P	Audio Recorder	Recording audio messages directly from the browser
	Moodle	Function in ATTO	The corresponding functionality is implemented in the built-in ATTO editor
	GWorkspace	Absent	
Creating flash cards	H5P	Dialog Cards, Flashcards	Several solutions are available
	Moodle	Absent	
	GWorkspace	Absent	
Creating test questions	H5P	12 types of questions	Drag and Drop, Drag the Words, Essay, Fill in the Blanks, Find Multiple Hotspots, Find the Hotspot, Image pairing, Image Sequencing, Mark the Words, Multiple Choice, Single Choice Set, True/False Question
	Moodle	15 types of questions + informal types of questions	Implementation of standard types of questions: Calculated, Simple Calculated, Drag and drop into text, Drag and drop markers, Drag and drop onto image, Calculated Multichoice, Essay, Matching, Embedded Answers (Cloze), Multiple Choice, Random Short Answer Matching, Select missing words, Short-Answer, Numerical, True/False
	GWorkspace	9 question types (in Google Forms)	Short answer, Paragraph (Essay), Multiple choice, Checkboxes, Dropdown, File upload, Linear scale, Multiple choice grid, Checkbox grid
Holding tests	H5P	Quiz	You can choose from only 6 types of questions; available mixing of questions, sample questions; not recommended for final testing
	Moodle	Quiz	Full-fledged testing with lots of settings, automatic checking and review of ratings; possible reuse of questions in different tests
	GWorkspace	Forms	Standard Google form with Google spreadsheets connected to display test results
Timeline creation	H5P	Timeline	Create a timeline with slides on timestamps
	Moodle	Absent	
	GWorkspace	Absent	
Interactive book creation	H5P	Interactive Book	Multi-page resource with an ability to embed almost any of the other elements of H5P on any page, including test questions
	Moodle	Book	Multi-page resource with text, graphic information, embedded video, audio; without the possibility of testing
	GWorkspace	Absent	

tive video” module directly in the Moodle environment (implemented in the training and information portal of NULES ).

In the absence of a learning environment in an educational institution with which H5P technology is already integrated, interactive learning content can be created and stored in the commercial cloud (<https://h5p.com>) or in the community one (<https://h5p.org>) (H5P, 2023). To use the H5P cloud, you need to register, after which users have the opportunity to post their own projects, optimize downloaded videos, adjust the parameters of educational analytics for students using individual projects, share materials on other sites and use additional features. The <https://h5p.org> site is an open resource for creating interactive materials, testing them, and commenting on resources created by other users. In addition, the Lumi desktop application has been developed for teachers who prefer to create offline learning content. In any of the three described options, the program interface is identical, simple and clear. So far, templates have been developed to create 49 types of H5P content (<https://h5p.org/content-types-and-applications>). They can be approximately grouped into three main categories: game content (Games), multimedia content (Multimedia), and methods of testing students’ knowledge (Questions).

Since a number of higher education institutions use learning management systems that have their own modules for creating interactive didactic materials to deliver educational content and organize e-learning (blended, distance learning), a comparative analysis of H5P, LMS Moodle and Google Workspace functionality was additionally conducted (table 1, 2).

As you can see from table 1 and 2, H5P technology has many more unique interactive learning elements than those that Moodle and Google Workspace can offer. In addition, H5P can be integrated into other learning management systems to expand their functionality and increase the freedom of teachers to use pedagogical technologies and disseminate their own learning content. It should be noted that unlike Moodle, in which H5P is fully integrated, integration with Google Workspace involves embedding individual elements from the site <https://h5p.com>. You can also download the created H5P element to a local computer as a file and then distribute it not only in learning management systems, but also on the sites of publishing systems to which this technology is integrated.

To determine the feasibility of using H5P technology for the development of didactic teaching materials and the readiness of teachers to use them in the educational process (the second task of the

study), specialized training of the academic staff of NULES and WUELS was conducted. Within the “Distance Learning Tools” course (<https://elearn.nubip.edu.ua/course/view.php?id=3000>) the representatives of the center of distance learning technologies NULES developed (<https://elearn.nubip.edu.ua/course/view.php?id=216>) a “Fundamentals of working with H5P” module, in which the teachers had the opportunity to get acquainted with the functionality and features of using H5P technology, as well as to develop separate didactic materials (figure 2).

To determine the attitude of the academic staff to the use of H5P technology in educational practice, a questionnaire was conducted (<https://forms.gle/CgVpKWYkqgaUUhm16>).

58 faculty members of NULES (46 members) and WUELS (12 members) were embraced by the questionnaire, who train future specialists in the field of technical sciences (41.7%), natural sciences (32.6%) and social sciences (25.7%). The vast majority of respondents are middle-aged people (5.7% – up to 25 years; 30.8% – 25-35 years; 41.3% – 35-45 years; 19.4% – 45-55 years; 2.8% – over 55 years old) with a sufficient level of digital competence (68.3% defined their own level of digital competence as sufficient; 25.6% – high; only 6.1% – basic). All respondents stated that they have experience in using e-learning resources, with 76.4% developing e-content independently. 100% of respondents supported the statement that the use of interactive educational content helps to increase students’ learning motivation; 91.3% agree that the study material needs to be adapted to the learning styles and needs of the students. Therefore, it is possible to make assumptions about the high degree of readiness of the academic staff to use interactive content in the educational process. At the same time, H5P technology is new for the vast majority of respondents (awareness of specialized training was determined): to the question “Do you know about H5P technology?” 14.1% gave an affirmative answer, and only 1.2% stated that they have experience in developing their own didactic materials.

Upon completion of the training, 63.6% of respondents answered the question “Do you consider it appropriate to use didactic H5P materials in your own e-learning courses?” in the affirmative, especially if there is sufficient and quality methodological support (100% of respondents need methodological assistance). 27.1% refused because, in their opinion, the development of H5P materials for the discipline they teach (mainly in the natural sciences) requires additional equipment, for example, for video recording, and their use is restricted under the copyright law. Only 9.3% of the surveyed teachers gave the negative

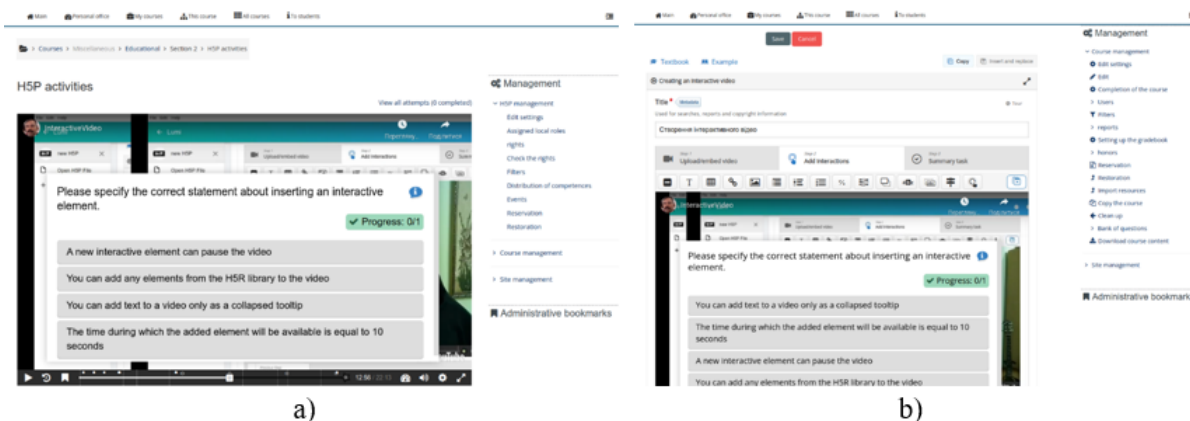


Figure 1: Example of an educational interactive H5P element in the Moodle environment (a – educational video viewing mode, b – interactive video editing form).

Table 2: Comparative analysis of H5P, Moodle and Google Workspace functionality (not all the available H5P functionality is considered).

Purpose	Program	Module	Features
Interactive video creation	H5P	Interactive Video	Feed interactive material directly in the video clip; with a possibility to add test questions
	Moodle	Lesson	Video feed by separate clips with a possibility of adding test questions
	GWorkspace	Absent	
Construction of an individual trajectory of studying the topic	H5P	Branching Scenario	Ability to write a transition script depending on the pphoice of transition and answers to questions
	Moodle	Lesson	
	GWorkspace	Absent	
Panoramic image creation	H5P	Virtual Tour (360)	Panoramic image with the possibility of transition and explanations of the elements in the picture
	Moodle	Absent	
	GWorkspace	Absent	

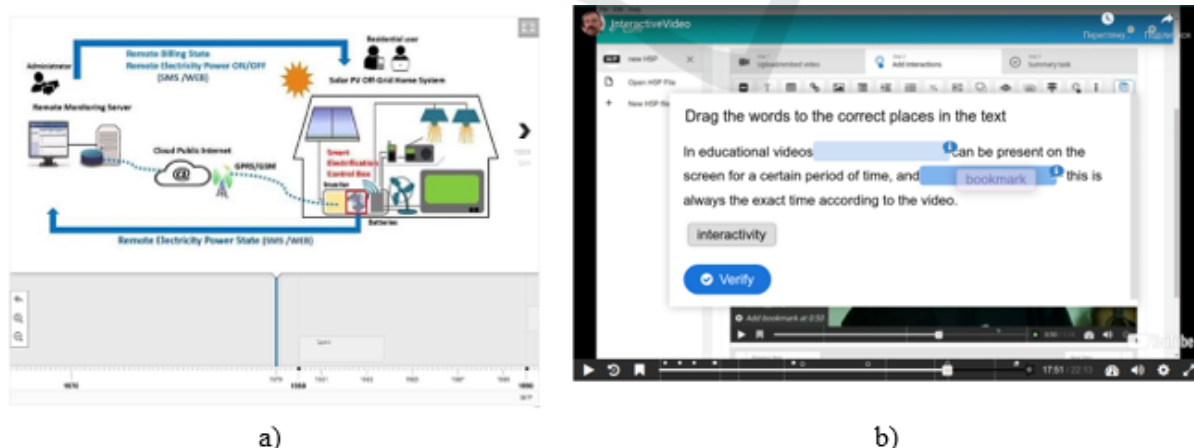


Figure 2: Examples of created interactive elements (a – timeline, b – interactive video with a question on top of the video).

answer.

Given the broad functionality of H5P, in the final questionnaire, researchers were asked to assess on a

5-point scale the pedagogical feasibility of using individual interactive H5P elements (table 1) in the learning process (group I questions) and the complexity of

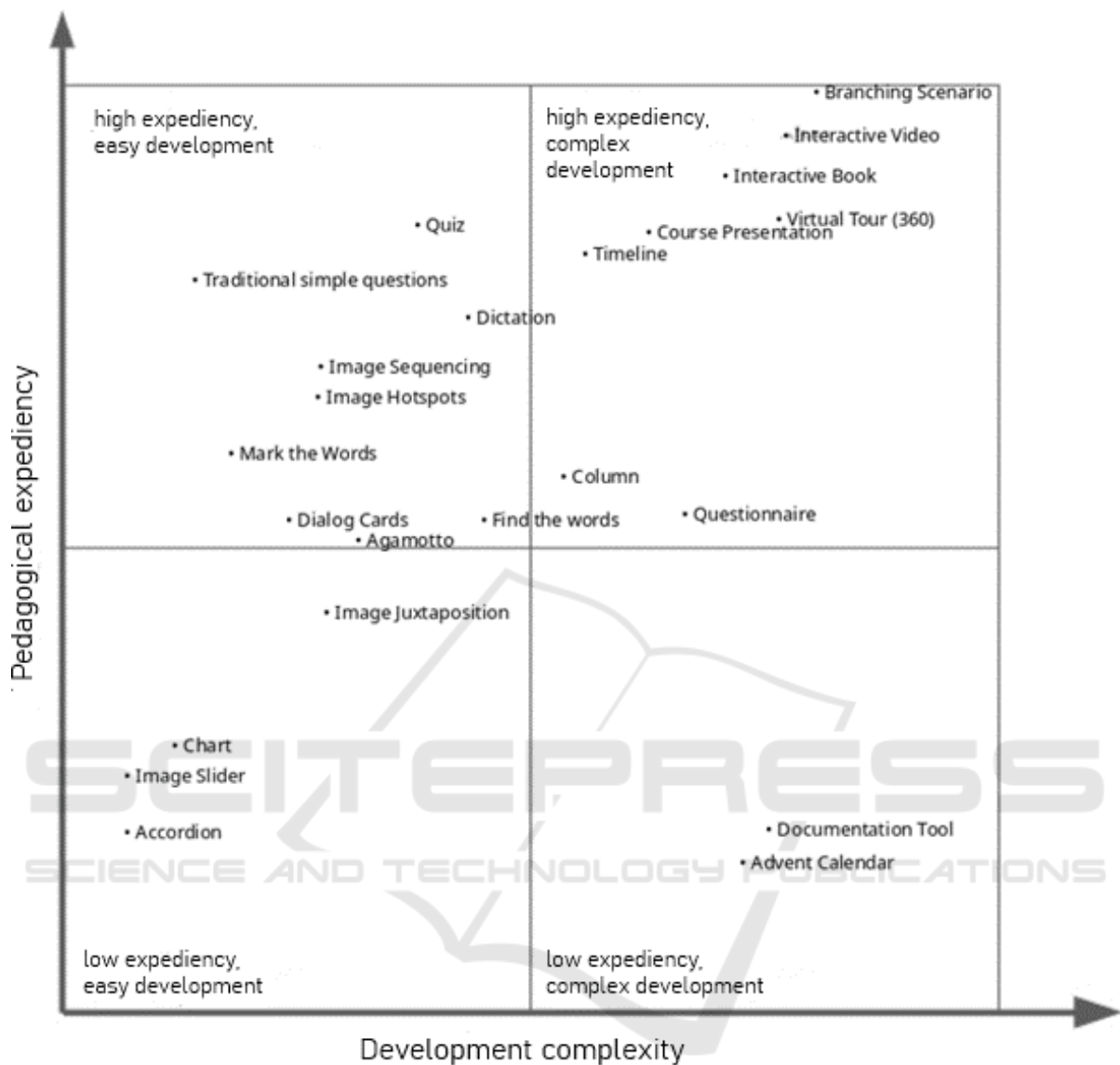


Figure 3: Matrix of correlation of development complexity and educational effect from application of separate elements of H5P technology.

their independent development (group II questions). Having created a matrix with four quadrants and reflecting the complexity of development (x-axis) and pedagogical expediency of application (y-axis), the authors visualized the attitude of the academic staff to the development and use of H5P didactic tools in the educational process (figure 3).

According to the academic staff surveyed (figure 3), the most optimal (high pedagogical expediency and ease development) is the use of different types of questions that can be added to the educational content. Not much more difficult to develop, but also appropriate, is the use of full-fledged tests. It should be noted that H5P developers do not recom-

mend using such tests for final assessment, but only for the current test of knowledge and self-assessment of students. It should be noted that the pedagogical expediency of using educational elements with a script game (“Branching Scenario”), interactive video (“Interactive Video”), interactive book (“Interactive Book”) is high, despite the relative complexity of their creation. Creating such interactive elements requires more prior training, digital competence, and implementation time from the teacher.

In general, the academic staff, according to the questionnaire, praised the educational effect of using H5P technology to support distance learning and noted their willingness to use it in the learning pro-

cess. The need for additional training related to the pedagogical design of e-learning courses and methodological support in the use of interactive didactic H5P materials in teaching specific disciplines was also identified. The latter is defined as prospects for further research.

## 4 CONCLUSION

The massive transition to distance learning caused by the COVID-19 pandemic has highlighted the need for additional research to ensure the quality of education under quarantine restrictions. In this context, many factors favor the usage of the H5P service to create and disseminate interactive content as a means of strengthening the motivation and involvement of students in active learning. It is evidenced by:

- openness: H5P is an open-source software;
- integration with learning management systems such as: Moodle, Canvas, Blackboard;
- wide range of templates: 49 templates have been developed so far, based on which you can create materials of different complexity and degree of interactivity;
- choice of operating mode: you can work with interactive learning material on your own learning site, in the <https://h5p.com> cloud environment or in the desktop application;
- personalized use: teachers and students can store the created materials in personal environments or portfolios.

The results of comparing the H5P service with the Moodle and Google Workspace learning management systems are grounds for claiming that the development of interactive didactic content using H5P meets the requirements for innovative educational resources, expands the functionality of learning management systems and increases teachers' freedom to use pedagogical technologies. The questionnaire, conducted upon the completion of specialized training of the academic staff of NULES and WUELS, shows a high degree of readiness of the academic staff to use interactive content in the educational process if they are provided with technical and methodological support.

Among the various options for didactic content that can be created using H5P, teachers prefer to use interactive elements using educational video. However, given the complexity of independent development of such elements, the need to create a bank of educational video with the involvement of specialists

in its shooting and editing is relevant. Instead, teachers have shown willingness to actively create a variety of test questions, as the proposed H5P templates significantly expand the functionality of LMS Moodle and Google Workspace.

Consequently, noting the potential of H5P as a tool to support distance learning in a broad context, the results of this study can be used by administrators and teachers of institutions of higher education to make a decision on the application of this technology in a specific HEI. Methodology of creating and using of interactive didactic H5P materials to support distance learning and professional development of the academic staff of Ukrainian and Polish higher education institutions are included in the prospects for further research.

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