Freeware Software in the Implementation of Interactive Educational Content[*],[**]

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Abstract. The article describes the position of the authors regarding the transition to domestic and free software in education. E-learning and distance learning should be free from information security vulnerabilities. The key point in the transition to Russian and free software is the ability to increase the degree of security for users, organizations, and the country as a whole. A comparative analysis of free software OEMDE Moodle and MS Teams applications based on the expert assessment of specialists from the Department of Information Education Technologies is given in the article. The advantages of the open environment of modular dynamic learning Moodle are confirmed by analytical data obtained in the process of interviewing students and teachers. It is noted that individual drawbacks of OEMDE Moodle can be leveled by fragmentary use of the Microsoft Teams platform. It is emphasized that the indisputable advantage of OEMDE Moodle is the ability to create interactive content, which in the process of visualization contributes to the activation of students' thought processes, the development of visual and cognitive reflection. Modern means of presenting educational information, such as infographics, scribing, storytelling, smart maps, virtual and augmented reality, are listed. The main interactivity of the H5P framework is described, which is compared to the main means of presenting information, indicated above. The principles of visualization of educational content through free software and the results of implementing in the innovative educational process are given.

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1   Introduction

In Russia, the most majority of computers used, among other things, in agencies and structures that are strategically important for the whole country, have Windows operating systems developed in the country that is our main geopolitical opponent. It would seem that the solution to the problem is obvious: we can transit to free and domestic software. However, the transition process is difficult for some main reasons [4]:

1. The quantitative component is the lack of a complete range of free and domestic software in all areas.

2. Functional component is not all hardware has drivers for full-featured use with domestic and free operating systems.

3. Perceptual component - it is generally considered that expensive foreign software is of better quality than similar free and domestic software.

4. Psychological component - the interface of the programs to which it is supposed to switch differs from those used, which entails the need to study a new interface.

The authors researched the basis of information available in the public domain on the Internet. The statistics of using various operating systems around the world are as follows (Table 1).

Table 1. Statistics of OS usage.

Windows, %	macOS, %	Linux, %	Others, %
80	11	8,5	0,5

Over the past 10 years, there has been a prospect of moving some Windows users to the Linux user category with an almost constant percentage of MacOS adherents. There are currently over 75 million Linux users worldwide. It is very important for them is the ability to work independently in Linux operating systems. This is because many of the open-source software (OSS) communities such as GENIVI, PolarSys, LibreOffice, and PostgreSQL prefer to control all their resources separately, and are not dependent on other corporations developing software [11].

The transition to domestic and free software is possible in the sphere of education in Russia. First of all, it can be in the field of informatics, information technology, and programming, as well as in the field of distance interaction and e-learning. E-learning and distance learning should be free from information security vulnerabilities. The key point in replacing Western commercial software with Russian and free ones is the ability to increase the degree of security for users, organizations, and the country as a whole.

2 Comparative Analysis of OEMDE Moodle and MS Teams and Recommendations for Their Use

Let's carry out a comparative analysis of two platforms for remote interacting in this article: MS Teams and the open environment of modular dynamic learning (OEMDE) Moodle.

Moodle is open-source software for building e-learning websites. We can say that this is the engineering standard for open-source learning platforms. The Moodle learning system is designed to solve a large list of technical, organizational, and pedagogical problems. With the help of the Moodle environment, you can optimize the virtual learning environment so that it meets the methodological and technical requirements of each educational organization [9].

Microsoft Teams is a paid corporate application from Microsoft for clients of Business or Enterprise versions of Office 365. This system is originally used to build communications within business companies with partners and is not intended for broadcasting educational content. To our mind, Microsoft Teams can only be used as an extra option to the specialized virtual learning environments. This platform can interact with students in real-time, which for many teachers becomes the main criterion for a complete transition to this platform when they carry out any form of classes (lectures, practical, laboratory work, control tests, tests, and exams). This is justified didactically and methodically only in some cases as our research shows.

Moodle does not provide online lectures. However, the teacher-developer of the training course can develop and place in it extensive lecture material with practical exercises and tests on each of the topics. It is possible to attach a video lecture file recorded, for example, using the free software Vokoscreen.

Microsoft Teams can share files between students and teachers. But the problem is that the files of each student become available to each representative of the open channel, which does not provide the required level of independence of students' educational activities. In OEMDE Moodle, such a form of carrying out training sessions can be organized through a special Task element. At the same time, students have the opportunity to send an answer to this task in the form of a file (files). At the same time, the teacher can monitor the process of completing the assignment at any time convenient for him.

For a didactic unit such as a test, Microsoft Teams has some options for test templates to create and edit. However, it is not possible to control the independence of the test execution due to the availability of files in the meeting channel. In OEMDE Moodle some test templates are varied in structure and purpose. During testing, test files and protocols are not available to other test participants, but only to the tested student and teacher. But at the same time, the teacher can control the testing process; see the protocol of answers and marks of each student after completing testing. Thus, the advantages of OEMDE Moodle are obvious already at this stage of the comparative analysis.

Here is the consolidated opinion of the expert group of associate professors and professors of the Department of Information Educational Technologies regarding these programs (maximum score - 10 points) (Table 2).

Taking into account the above mentioned, we can formulate some recommendations for using MS Teams and OEMDE Moodle:

1. For lecture-type lessons, it is more efficient to use MS Teams if you need screen sharing, direct dialogue, and instant response during the lesson. At the same time, if lectures are designed in the form of presentations or video files, then they can be full-fledged elements of training courses in the Moodle learning environment.

2. OEMDE Moodle is the most effective for practical and laboratory studies. In this environment, students' answers to the tasks received during the class are systematically grouped, they are not available to each member of the course team, and it is possible to re-send the file with the corrected work with the fixation of this fact by the teacher and the recording of a comment for the student.

3. Carrying out test papers is also the most rational in the Moodle environment, since students' answers are available only to the teacher, but not to other members of the course team. This environment provides a greater variety of test types than MS Teams.

4. It is more efficient to carry out exam tests with the parallel use of MS Teams and OEMDE Moodle: students perform the examination test in OEMDE Moodle while being in the MS Teams meeting channel for implementing educational proctoring.

Table 2. Expert assessment of software products.

Expert judgment criterion	MS Teams	OEMDE Moodle
Ergonomic interface	8	10
Free license	-	+
Linux-like OS compatibility	+	+
Lecture element properties	10	8
Item Properties Task	4	10
Test element properties	4	10
The presence of special elements of interaction for creating training course	3	10
The general level of proctoring of educational content	3	10
Total points	32	58

At the beginning of the experiment of studying the frequency of using and combining one or another software, according to the survey results, the following differentiation was most often observed: teachers use Microsoft Teams to deliver lectures, and Moodle to implement practical and laboratory classes. Only Microsoft Teams or only Moodle is less often used to carry out all forms of classes, which we consider insufficiently productive both in an organizational and didactic context. The least popular option was when both systems were used in parallel (see Fig. 1).

Longitudinal experimental studies of the authors have shown that it is the last option of the above (the parallel use of OEMDE Moodle and Microsoft Teams) turns out to be more optimal and not more laborious than others, both in terms of the implementation

of cognitive processes and in the organizational sense. Thus, the control groups during questioning and interviewing showed the following results. To the question «What difficulties did you have with the parallel use of these two platforms?», the answers were received: 7.2% of students experienced difficulties with the hardware; 4.2% of students did with software; 88.6% of students did not face any difficulties in parallel applying these two platforms. 89.6% of students consider such a combination of electronic resources to be the most convenient, and only 4.2% do not agree with this or would prefer to use other platforms (6.2%)
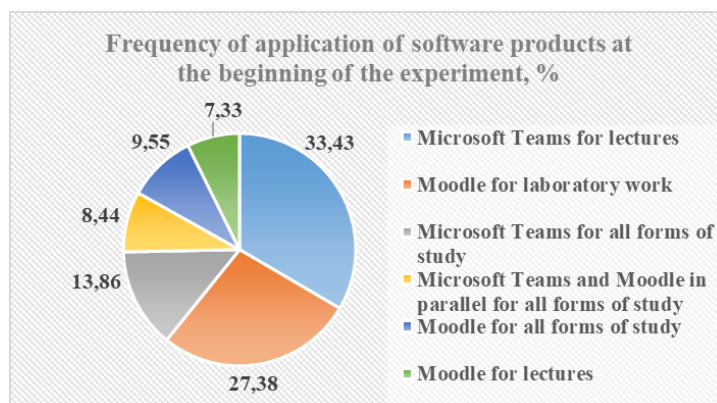

Fig. 1. Frequency of using and combining software when carrying out distance learning at the initial stage of the experiment.

Taking into account the above recommendations of the experts, some of the teachers corrected their activities and after the experiment was over, the picture changed the following way (see Fig. 2).
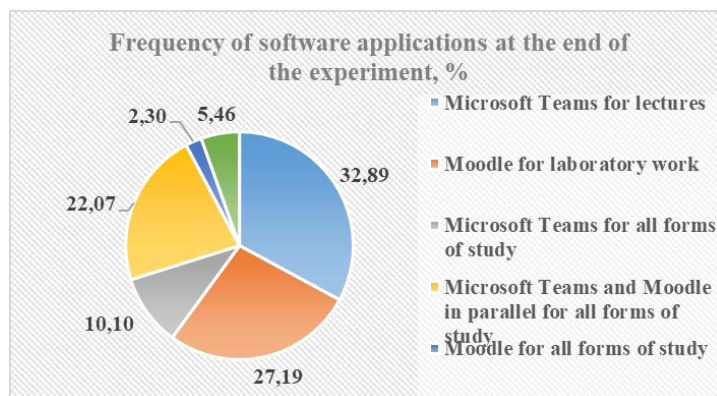

Fig. 2. Frequency of using and combining software when carrying out distance learning at the final stage of the experiment.

To the question «How did your level of frustration (negative experiences) change in the course of online classes with the parallel use of MS Teams and OEMDE Moodle platforms?» the result was obtained: increased - 0.0%; decreased - 91.4%; did not change - 8.6%.

Thus, we see that the combination of two platforms: MS Teams and OEMDE Moodle provides a decrease in the level of frustration, which was additionally confirmed by G. Eysenck's self-assessment test of mental states at the beginning and the end of the experimental distance course.

Optimization and the possibility of stabilizing the psychological state of participants in the educational process is an unconditional quality criterion for distance technologies using free software.

3   Features of the Modern Students Mental Activity and Modern Means of Presenting Educational Information

Let's consider this aspect in detail: we will note the peculiarities of thinking of modern students, suggest ways to enhance the visual and interactive components of educational content through certain types of free software.

The data of a survey made by us with students of various courses and areas of training (the sample consisted of more than 200 people) showed that the mental activity of modern students is characterized by some significant characteristics:

- Intellectual ambivalence (striving to obtain the maximum of new knowledge with minimum labor costs);

- focus on digital media (more effective perception of information on digital media, the actual rejection of paper media);

- greater sensitivity to external visual stimulus in comparison with the auditory stimulus (during the experimental interview, the diagnosis of the dominant perceptual modality was also carried out. For this, the Torrance test was used, which serves to determine the leading type of perception: auditory, visual, or kinesthetic. More than 80% of students, according to the Torrance test, the visual channel of perception was determined as dominant).

Cynthia Leea, Seeshing A.Y., Tiffany Ip obtained similar results in their studies in the article «University English language learners' readiness to use computer technology for self-directed learning» [10]. The authors found that students with an abstract-sequential learning style show greater confidence in using computers for independent learning and are characterized by a lower level of anxiety than students with an abstract-random, concrete-sequential, or concrete-random learning style. It was noted that in some situations women with an abstract-casual learning style were not receptive to computer instructions. But overall, gender differences are not statistically significant. Also, no statistically significant effect of correlation between gender and age was found.

However, as the authors note, from a different perspective on different learning styles, visual and kinesthetic were recognized as styles that facilitated the use of computer technology by university students in Hong Kong. Students with these learning

styles used computer technology to solve problems and retrieve learning materials, compared to students with auditory and tactile learning styles. It was also found that such a factor as «desire to learn» is the strongest factor influencing the use of computers by students in the process of independent work.

It is likely that regardless of which pedagogical methods teachers choose, they are responsible for finding the most optimal way to implement them in their learning contexts and for motivating students to study independently. Therefore, it seems necessary to study the correlations between such constructs further: the chosen pedagogical methodology, educational context, type of individual learning, and personal factors.

Including visually interactive constructs in educational content is psychologically and didactically justified because of the above-mentioned reasons. To implement this, we propose to introduce such free software as H5P into the educational process.

Thus, taking into account the listed features of students' mental activity, modern technologies for presenting educational information should be integrated into the educational process. These include the following:
- infographics;
- scribing;
- mind maps;
- storytelling;
- the virtual reality;
- augmented reality.

Some authors [2] interpret scribing as one of the directions of the modular visualization process and propose such a didactic technique as scribing presentations to be more actively involved in educational activities.

Another way of visualizing educational information is very interesting - through the intelligence of maps, described in one of the works of O.V. Ivanova [1]. The author interprets the interactive mind map as an electronic educational resource (EER) that allows information to be presented visually, graphically, nonlinearly, with some missing elements that the user must restore.

The effectiveness of the knowledge mapping process to improve the quality of education is also emphasized in the works of O.V. Nazarova, S.P. Shmalko, A.G. Perov, V.V. Shevtsov [6; 7].

The authors of the listed works believe that the Knowledge Card should also reflect the competencies that the student must acquire upon completing the study of the topic. In this case, the student sees what knowledge, abilities, and skills he will need further in his professional activity, and how, already at the stage of training in an educational organization, he should build his program of self-management and personality marketing. These studies provide a classification of Knowledge Maps (elementary, inductive, deductive, etc.) and the principles of their construction (the rule of homogeneity, zoning of constructs of explicit and implicit memory, enhancement of the dynamic characteristics of voluntary attention, generation of positive absorption).

Moreover, O.V. Nazarova and A.G. Perov expressed the idea of the need to increase the level of the visual component of the student's and teacher's mental activity (visual-spatial and emotional intelligence) through specialized technologies and techniques [5].

Implementing such educational technologies as virtual reality, augmented reality requires significant financial investments. At the moment, there is no special free educational software for simulating virtual or augmented reality. But some of the interactions of the H5P program allow simulating individual elements of the virtual environment (see Fig. 3).

These figure maps show each presentation technology corresponds to the core tools for creating interactive learning content in the free H5P shell.
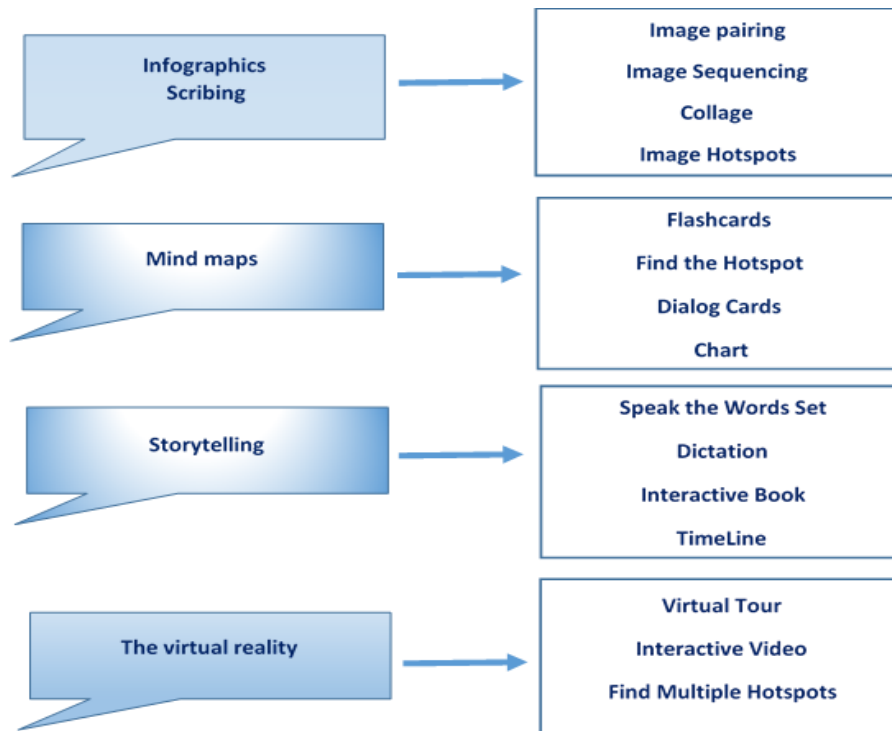

Fig. 3. Modern technologies for presenting educational information and the possibility of their implementation through the elements of the H5P framework.

4 Main Features of the H5P Plugin for Creating Interactive Content

Also, it is important to note that the ability to create interactive content using the free H5P framework is provided in the Moodle learning management system. This is undoubtedly another indisputable advantage of the Moodle environment. The H5P toolkit is especially effective when used with blended and distance learning technologies. Educators can create and edit interactive videos, presentations, games, mind quizzes, and

more with the help of H5P. The generated interactive content can be imported and exported. It is responsive and mobile-friendly; therefore, student users will be equally successful with it on computers, smartphones, and tablets. The H5P interface offers significant possibilities for creating visual interactive content (Table 3).

Table 3. Classification of interactive content in the program H5P.

Types of interactive content in the H5P program (interactivity)		
Games (A game form of content)	Multimedia (Multimedia content form)	Questions (Format of interactive questions)
Name and a short description of some of the main interactions, depending on their type		
1. Arithmetic Quiz Create math quizzes and computational interactive tests	1. Find the Hotspot Create an image access point for students to find	1. Drag the Words Create quizzes in which you need to match words by moving them
2. Find the words Word search game in a special table	2. Dictation Create a dictation with instant feedback	2. Fill in the Blanks Create text tasks with missing words in the text
3. Flashcards Create stylish and modern cards to organize the dialogue	3. Image Sequencing Place images in the correct order	3. Guess the Answer Create a test with a choice of one correct answer from the list
4. Image pairing Dynamic image matching game creating interactive	4. Interactive Book Books and disciplinary courses	4. Mark the Words Test in which students highlight the correct answers with an electronic marker
5. Memory Game Mnemonic game to activate perception and memorization	5. Speak the Words Set Speech recognition (students' answers to questions) with feedback	5. Multiple Choice Creation of a test with multiple choice
6. Virtual Tour Create an interactive virtual learning environment	6. Interactive Video Create videos enriched with interaction with students	6. Questionnaire Create a feedback questionnaire
7. Branching Scenario Self-study interactive dilemma exercises	7. TimeLine Recreate event history	7. Advanced fill the blanks Create a test that requires filling in gaps in words or images

5   Principles of Visualization Interactive Content

When creating interactive content, some important conditions must be observed, which we call visualization principles (see Fig. 4). These principles were formulated by us in the process of studying the attitude to the problem of visualization of both domestic and foreign scientists (Antonova A.V., Romanova L.M., Ulyanova I.V., Grushevsky S.P., Ivanova O.V., Ostapenko A.A., C. Vieira, P. Parsons, V. Byrd, B. Jonsson, M. Norqvist, Y. Liljekvist, J. Lithner, L. Costica, and others) [12-15] (see Fig. 4).
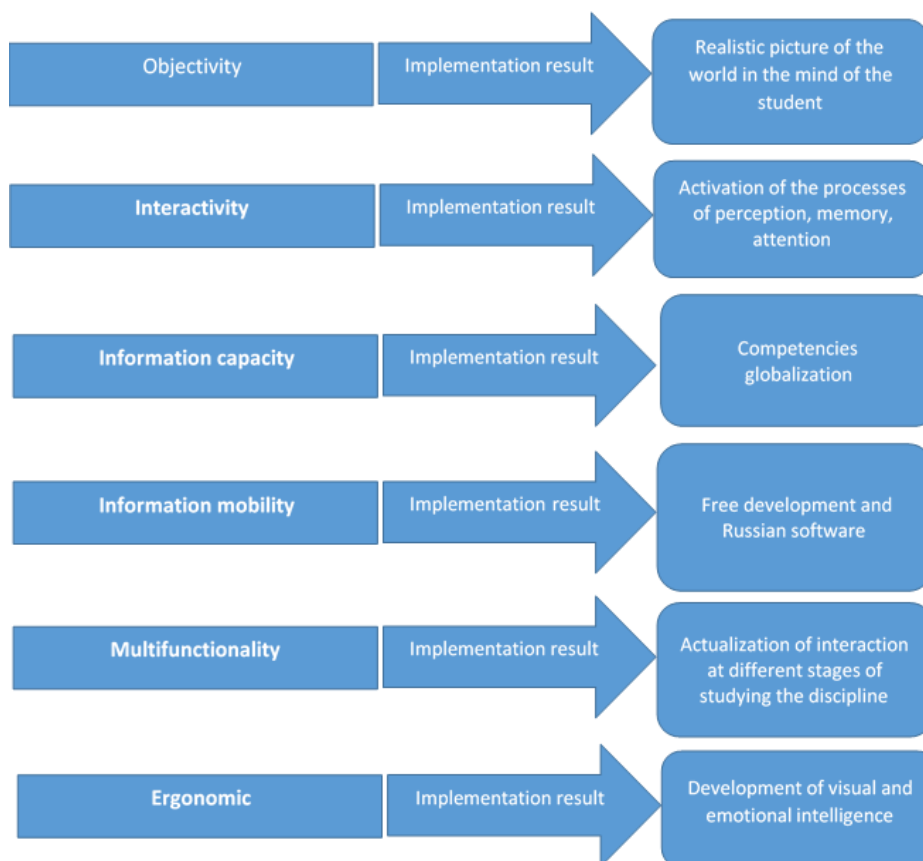

Fig. 4. Principles of visualization implementing interactive content using free software.

The properties and patterns of objects and phenomena are realistically visualized with the help of modern IT creation of interactive content (the principle of objectivity). Interactivity is the ability of visualization mechanisms to directly influence thinking processes. The ability to place a large amount of information of various types in one visual-shaped unit is reflected in the principle of information capacity. Information mobility is ensured by the fact that standard hardware and special free software are sufficient to

demonstrate visual didactic constructs. Interactive content is relevant at different stages of studying the discipline, which is the principle of multifunctionality. And finally, when we say ergonomics we mean the presentation of information not only in an easy-to-understand sequence but also an effective emotional combination of sound and visual images.

When implementing the above-mentioned principles, one more task of innovative educational activity using free software is achieved - improving the quality of distance learning, since the rejection of traditional mechanical perceptual actions and their replacement with a complex of emotionally attractive interactive visual-figurative modules leads to a meaningful in the internal plan of action, the process of understanding and assimilating educational material [3]. Such indicators of the quality and knowledge formation among students improve as the speed of performing creative tasks, the ability to analyze and synthesize educational material, which is expressed in the ability to mentally fix the logical-associative connections of the studied elements of the system of objects under study, which in general indicates an increase in the independence of thinking and strengthening of personality self-reference.

6   Conclusions

Summarizing all of the above mentioned, we will formulate the following conclusions:

- information and communication support for training contributes to the expansion of institutional communication and cooperation in the interests of education, as well as the improvement of information, management, and didactic activities at the level of educational organizations;

- new information technologies facilitate a rapid transition from an explanatory learning model to a student-centered model, which implies the use of constructive teaching methods, provides teachers with quick feedback of student activities and new resources for developing individual learning;

- development and improvement of humanistic education are impossible without updating the main directions of innovative teaching. The same is required of educational systems by the ever-accelerating processes of globalization and digitalization. The problem of compliance of pedagogical principles with the requirements of rapidly developing innovative educational systems can be solved by updating students' cognitive reflection and visual-interactive components of thinking through the use of special free software.

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