

Informatics teacher's training for design of innovative learning aids

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Abstract. In accordance with its goal, the paper covers practical aspects and experience of Informatics teachers' preparation for the design of innovative learning aids as one of the important components of the renewed model of teachers' training. Theoretical background of the research includes holistic educational approach and functional basics of electronic didactic aids development. The specific example of such an experience (students' project activity on the design of English multimedia tutorial for schoolchildren) is depicted in details. The prospects of further research are outlined.

Keywords: model of Informatics teachers' training; holistic education; cloud-based cognitive environment; design of innovative learning aids, multimedia tutorial.

1 Introduction

The process of training of pre-service Informatics teachers is a complicated task which nowadays needs for modernization. It becomes incredibly urgent and topical due to some factors connected with the requirements to a contemporary Informatics teacher. These factors include rapid development and changing of digital technologies; challenges to work at school with a new generation of so-called "digit-natives" who have their cognitive peculiarities and special educational requests; growing demand for IT-specialists on the labor market. These factors encourage changing the role of Informatics teachers who have to be able to raise and educate schoolchildren in the lines of advanced interest to Computer Science, its deep understanding, and motivation to potential professional activity in IT-sphere.

Thus, it becomes really important to build the renewed model of teachers' training on the basis of new paradigms. One of such a paradigm might be the holistic educational approach, which is emphasized in a number of normative documents, such as the Concept of the New Ukrainian School [4], the National Strategy for the Development

of Education in Ukraine for 2012-2021 (2013), the Law of Ukraine “On Higher Education” (2014), the Law of Ukraine “On the Concept of National Education information programs” (2015), Education for Sustainable Development Goals: Learning Objectives (UNESCO, 2017) and others.

According to recent research papers on the theory of holistic education it is considered as a paradigm which provides educators with a system of principles that can be used in various ways [3; 10; 13; 12]. The central idea of holistic education is the cohesive development of the whole personality of a trainee both at the intellectual and emotional levels [16]. It is also emphasized that such a cohesive development should be supported by strong links between personal experience and real life problems.

On the other hand, the evidence of real educational practice testifies that productive and important ideas of holistic paradigm are accepted in quite a limited way without using its significant facilities as for providing integrity at the levels of the content of education, means and forms of its implementation.

Minding these speculations, at the developing of the renewed model of the Informatics teachers’ training, we eager to implemented holistic approach in the complex of various aspects, in particular: to form the content of Informatics learning, to select the proper ways of it representation and mastering, and to arrange professional educational practice for pre-service Informatics teachers. This idea is specified in the implementation of (1) concentration and generalization of Informatics educational content basing on the integrative approach to the structuring of the curriculum disciplines in pre-service teachers’ training; (2) multi-code representation of the educational content directed on the stimulating of cognitive processes; (3) natural merging of teachers’ educational practices with innovative ICT applications to real-life challenges that can be achieved via project-based learning. It is important to point out that the said aspects at the same time cause and complement each other. In such a way the holistic idea obtains more comprehensive understanding and deeper penetration into educational practice.

In this context, particular attention must be paid to teachers’ preparation for design and implementation of efficient didactic aids which are able to provide holistic approach to classroom activity at learning of different school subjects. Thus, one of the important components of the renewed model of Informatics teachers’ training based on the holistic approach (covered and justified above) is the teachers’ preparation for the design of innovative learning aids.

The purpose of the article is to cover practical aspects and experience of this kind of training.

2 Theoretical framework

During the research, the set of theoretical, empirical, and modelling methods were applied. In terms of mentioned model of the Informatics teachers’ training built on the holistic approach, their preparation to design of innovative didactic aids is realized comprehensively in the process of learning of the complex of curriculum disciplines (both of common and vocational training) and via the project-oriented activity.

Theoretical background of the teachers' training for development of innovative learning aids, in particular, e-tutorials, can be considered holistic educational approach (covered above in brief) and functional basics of electronic didactic aids development.

Problems of defining didactic functions of e-learning guides and functional approach to their design have recently become the focus of researchers and practitioners (in particular, of Liudmyla I. Bilousiva [3], Liudmyla E. Gryzun [6], Volodar V. Kraevskii [8], Isaak Ia. Lerner [9] and others). This approach is based on a deep analysis of the didactic functions of the textbooks and the means of their implementation. It opens practical ways to develop the structure of e-tutorials that can be used as a theoretical basis for their projecting [15; 17; 14]. The project embodies the idea of a tutorial as an object of creation. The process of e-tutorials design includes determining the structure of the tutorial that fixes the interconnections of its components, establishes the mechanism of implementation of these links, etc. Functional approach to creating of an e-tutorial enables to establish the functional load of its structural elements and the connection between the performance of their necessary functions [2; 6; 8; 9]. These ideas become increasingly important nowadays in the context of exactly multimedia tutorials design, as their role is getting more and more essential in education.

As it was said above, the process of contemporary tutorials development must rest on their deep learning as an object of design. Thus, it is relevant to reveal that a multimedia tutorial in its state-of-art sense has been recently transformed into the integral learning environment which adsorbs functions of the whole complex of learning aids. It has happened due to attracting to its design advanced multimedia and cloud-based technologies.

Among the leading features of a multimedia tutorial ([2; 5]), it is possible to distinguish the following basic didactic functions: informational, transformational, systematic, integrating, coordinating, developing, the functions of consolidation, self-control, self-education. Thus, projecting the structure of any multimedia tutorial it is necessary to provide proper components for leading didactic functions realization.

The covered above theoretical background made a basis for arrangement of pre-service Informatics teachers' training for the design of multimedia teaching aids.

3 Results and discussion

The practical aspects and experience of this kind of training are covered below on the example of students' development of multimedia tutorial for English learning support. The tutorial was designed in the process of the students' project-oriented activity which rested on the previous learning of such curriculum subjects as Programming, Computer Graphics, Pedagogy, English (common academic subjects) and Computer-oriented systems of learning, Basics of E-pedagogy, Design of didactic aids (professionally-oriented subjects).

On the initial stage of the project the didactic functions and structure of the multimedia tutorial were specified due to needs and problems of foreign languages mastering at school.

In particular, pre-service Informatics teachers' revealed basic demands to the tutorial, determined its functional facilities and defined its structure. In such a way, there was concluded that in order to provide the fulfilment of the leading didactic functions the English multimedia tutorial for 6th grade pupils has to realize the set of facilities. First of all, it must provide high-quality visualization of educational content and interactive dialogue with a trainee. It will help to realize in proper way informational, transformational, developing didactic functions, as well as functions of feedback, correction and control.

It should also ensure that the acquisition of linguistic competence is enhanced by the complex involvement of many information perception organs, which will provide the implementation of transformational and developing functions.

The tutorial also has to enable working out of various skills of speech training and in such a way to realize systematic and consolidation functions. It should guarantee the cognitive activity management including game activity for ensuring realization of didactic functions of developing and self-learning. In addition, the tutorial must provide a strong feedback with a teacher and other trainees to obtain consultations, help, assessment etc.

Finally, the tutorial has to be easily integrated with other e-resources which will guarantee it integrative and coordinative didactic functions.

Based on the above functions and relying on research [1; 7; 11], it became possible to design the structure of the multimedia tutorial, since it is conditioned by the need to implement its didactic functions. Thus, students concluded that the tutorial should be the complex of interconnected components characterized below.

For high-quality information visualization, the tutorial should include a *multimedia illustration library* that offers text, graphics, video, and audio materials.

To build language competence via the comprehensive involvement of many sense organs, the tutorial contains an *interactive video library* with didactic support.

To develop a variety of skills, the manual has a *bank of interactive exercises* with an immediate output of the results of their implementation.

For learning activity management, the tool has a *learning activity management component* with repetition of the material and involvement of game elements.

To automate the processes of information retrieval and integration with other electronic sources, the manual has a *technological component* that will provide its online uploading and the ability to be integrated with other resources.

To communicate with the teacher and other students, the tutorial has an appropriate component.

Defined and specified didactic functions and structure of the multimedia tutorial became the basis of its design.

Thus, on the subsequent phases of the project the multimedia English tutorial for 6th grade schoolchildren has been developed with the help of the tools of Ourbook environment, whose capabilities were enhanced by the students' programmed elements. It's worth noting that it does not need to be installed or downloaded due to the fact that it is a cloud-based multimedia book called MultiEnglish. It covers the main topic taught in the 6th grade during English lessons: My family, My friends, Shopping, Food, Sport, Traveling, Ukraine, Great Britain, School life (Figure 1).

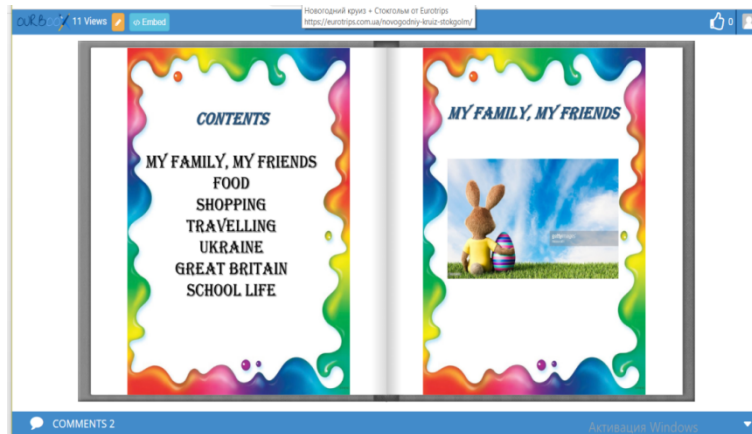


Fig. 1. Content of the multimedia tutorial

Each topic is represented in four headings (Let's focus on...) that target formation and development of four basic language skills: Let's focus on Vocabulary, Let's focus on Reading, Let's focus on Grammar, Let's focus on Listening and Speaking, Let's focus on Writing (Figures 2-6). The sections contain relevant teaching materials, questions, tasks and various exercises. The demo version of the tutorial is available via the link (<https://www.ourbox.com/books/multimediaenglish/>).

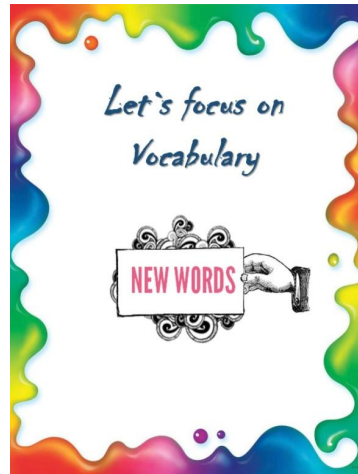


Fig. 2. Category Let's focus on Vocabulary

While designing the tutorial, according to its didactic functions and structure, standard features of the Ourbox environment have been extended by HTML markup programming.

Adding appropriate language instructions allowed students to supplement the tutorial with interactive elements of other services that are not provided by the Ourbox

environment toolkit. In particular, training exercises, interactive videos, interactive posters, games, static and dynamic illustrations, hyperlinks of a number of services (LearningApps, Quizlet, YouTube, Edpuzzle, Vizia, Gettyimages, ThingLink, ESL Game Plus, Jigsaw Planet, Google-forms) were integrated into the tutorial (Figure 7).

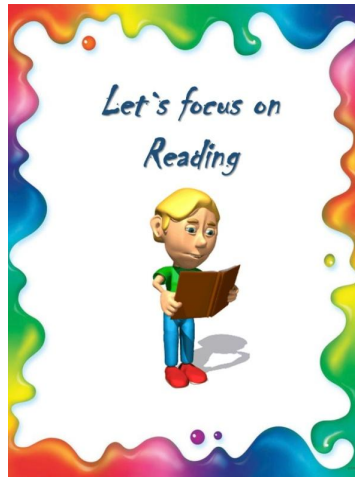


Fig. 3. Category Let's focus on Reading

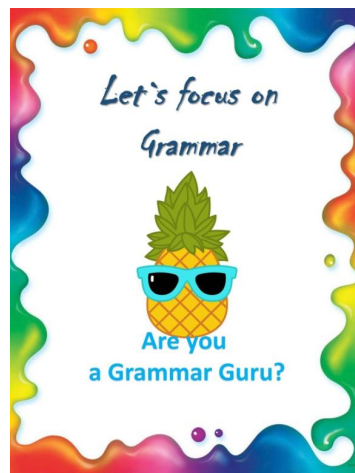


Fig. 4. Category Let's focus on Grammar

In addition, due to editing the HTML code of the tutorial pages, the media content was created. For example, the students-developers could combine text, graphics, video elements and the necessary hyperlinks (Figure 8).

Using HTML, it was enhanced Ourboox's capability to format text. For example, it was developed code fragments in HTML with CSS elements to align text (Figure 9) and to create numbered lists (Figure 10).



Fig. 5. Category Let's focus on Listening and Speaking

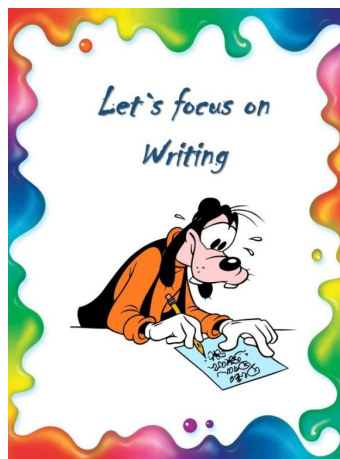


Fig. 6. Category Let's focus on Writing

The screenshot shows a multimedia tutorial interface. The main window displays a 'Grammar' section with text about adverbs of manner and a video player. The video player shows a red double-decker bus and a sign that says 'Английские наречия на -ly'. A 'Source code' window is open on the right, displaying HTML code for the video player.

Fig. 7. An example of an interactive element of a multimedia tutorial embedded with HTML

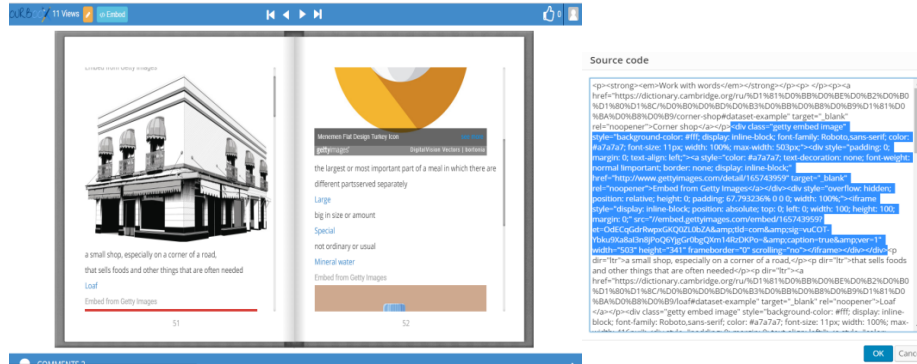


Fig. 8. Creating multimedia content by editing HTML

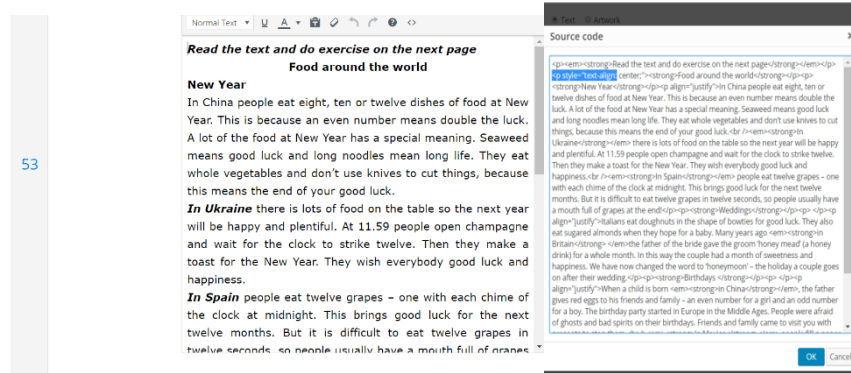


Fig. 9. Extension of text formatting with HTML using CSS elements

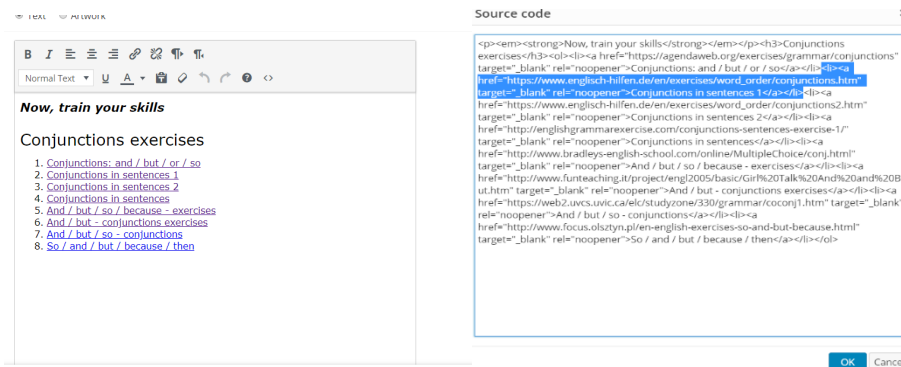


Fig. 10. Create of numbered lists using HTML with CSS elements

In addition, students-developers programmed integration with interactive didactic support into the tutorial. This element allows a trainee to watch the video with a pause at the marked places and do interactive tasks to the video story.

On the whole, thanks to the programmed elements that were added, the multimedia tutorial is able to perform all its didactic functions, defined at the first (theoretical) stage of the students' project.

At the final stage of their project, pre-service Informatics teachers do analysis and reflection of the designed tutorial, revealing its didactic features.

Discussing the didactic capabilities of the MultiEnglish multimedia tutorial, designed on the basis of a functional approach by the pre-service Informatics teachers at their project activity, we would emphasize its following features. The tutorial provides high-quality visualization of educational information and interactive dialogue with the student. A vast library of multimedia illustrations of the application visualizes the necessary elements of the educational content and provides instant feedback. The library contains static and dynamic illustrations of various types, including interactive posters. This type of illustrations enables quick boosting and checking a trainee's vocabulary (Figure 11).

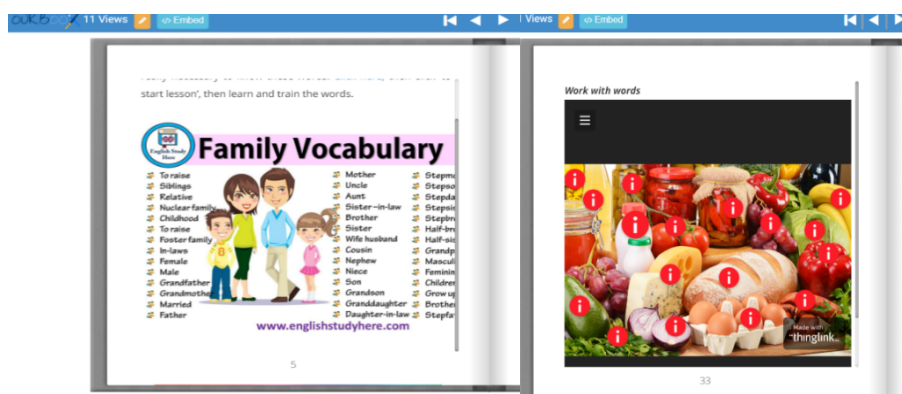


Fig. 11. Fragments of work with the multimedia illustration library

This tutorial capacity provides high-quality implementation of informational, transformational, developing didactic functions, as well as the functions of feedback, correction and self-control.

In addition, the tutorial enhances the effectiveness of language competencies through the comprehensive involvement of multi-senses activities. In particular, the tutorial allows you to organize the learning activities of the student with interactive video stories, for which it has been developed appropriate didactic support. Thus, while viewing the pupil is provided with the tasks that develop their audio skills, replenish their vocabulary, encourage the conscious using of grammar (Figure 12).

Also the multimedia tutorial has the ability to record a student's speech in order to develop his or her oral and communication skills (Figure 13). This helps to realize the transformational and developing functions.

The manual provides training of various skills and can be used as a simulator. The Bank of interactive exercises offers the trainee a variety of tasks of different formats: word search, matching, interactive text, puzzle solving, audio and video tasks. In such

way, the systematic and anchoring functions are realized. Fragments of different types of training tasks are shown in Figures 14-17.

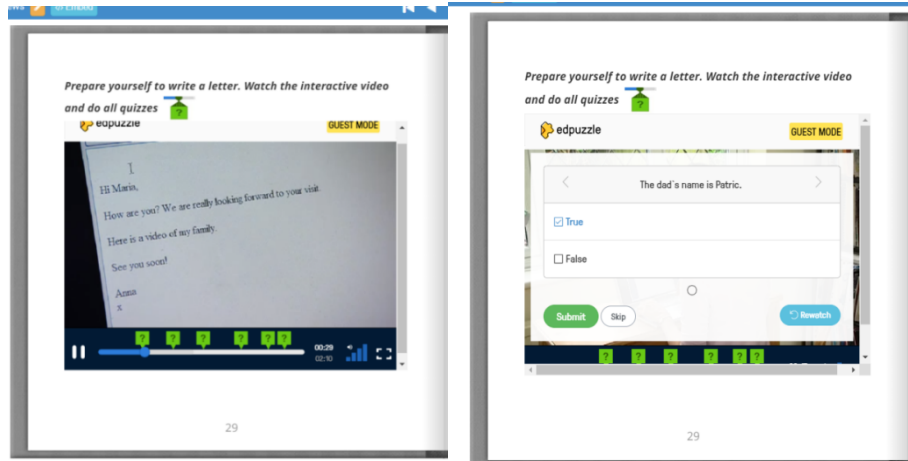


Fig. 12. Fragments of the using the interactive video “My Family”

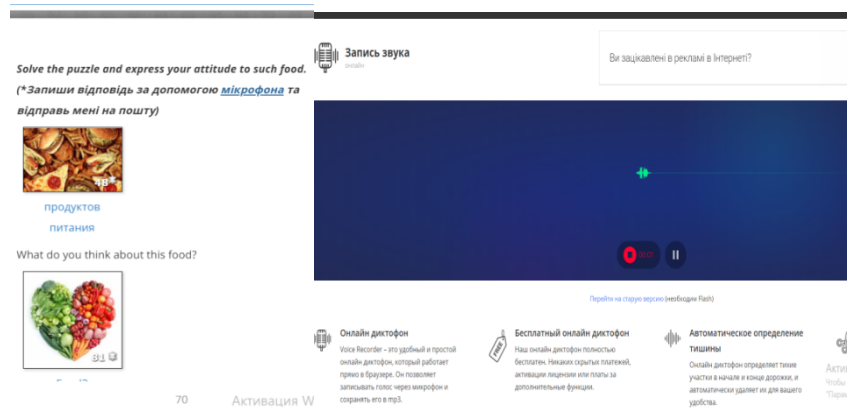


Fig. 13. A fragment of a student's voice recording while learning the topic “Food”

The functionality of the developed multimedia tutorial also includes the arrangement of cognitive activities, including game activity. That means that a trainee is able to work at their own pace, both independently and under the guidance of the teacher. In addition, all of the tasks offered to the student can be performed several times to achieve the best results. In order to increase motivation for learning, the tutorial involves pupils into game activities. It offers quizzes, crossword puzzles, cognitive grammar trips, quests etc. (Figure 18). These kinds of activity provided by the tutorial ensure fulfillment of the developing, systematic and consolidation functions.

The tutorial expects technological capability of its uploading to other websites and be integrated easily with other electronic sources and environments (Figure 19), which

facilitates the implementation of integrating and coordinating functions. It is also essential that the tutorial works correctly with all browsers like Google Chrome, Microsoft Edge, Opera, Mozilla Firefox, Internet Explorer, Yandex Browser.

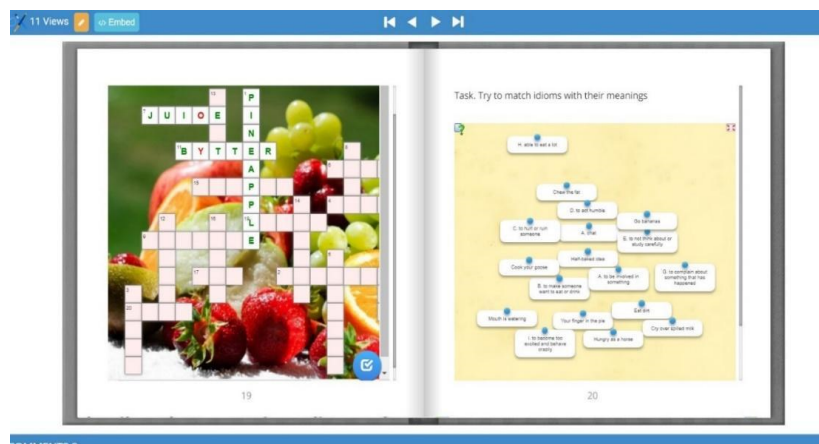


Fig. 14. A fragment of matching and interactive crossword puzzles

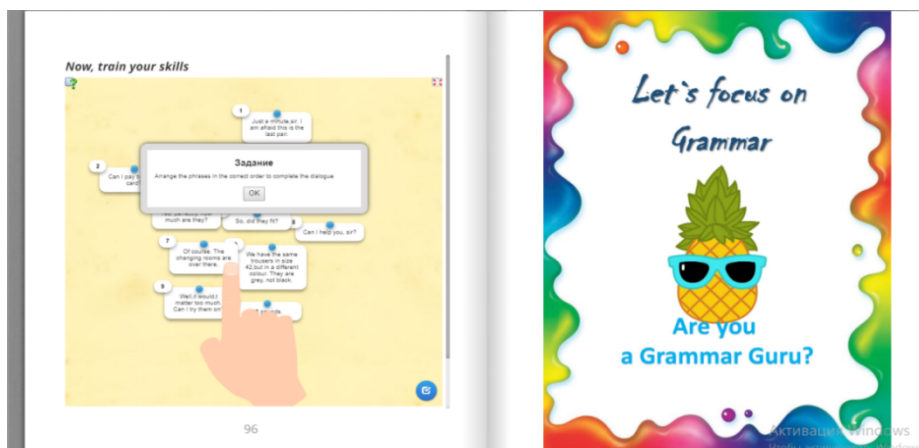


Fig. 15. Fragment of the ordering task

In addition, the tutorial has the functionality, which helps students to communicate with their teacher. For example, *comments element* can be used to ask questions, to do the exercise, send a speech to a teacher, or ask for help from other trainees (Figure 20). In such a way, the tutorial implements the didactic feedback function.

Thus, the analysis of the developed multimedia tutorial (provided by the students on the final stage of the project) testifies that the tutorial designed on the basis of functional approach becomes really innovative, as it creates for a trainee the integral cloud-based cognitive environment oriented on the activity-centred learning. In fact, the tutorial provides pupils with a platform for their independent cognitive activity, for their

motivation to learning due to availability of tasks choice and ways of their fulfilling. As a result, it promotes cohesive development of both of students and their potential pupils.

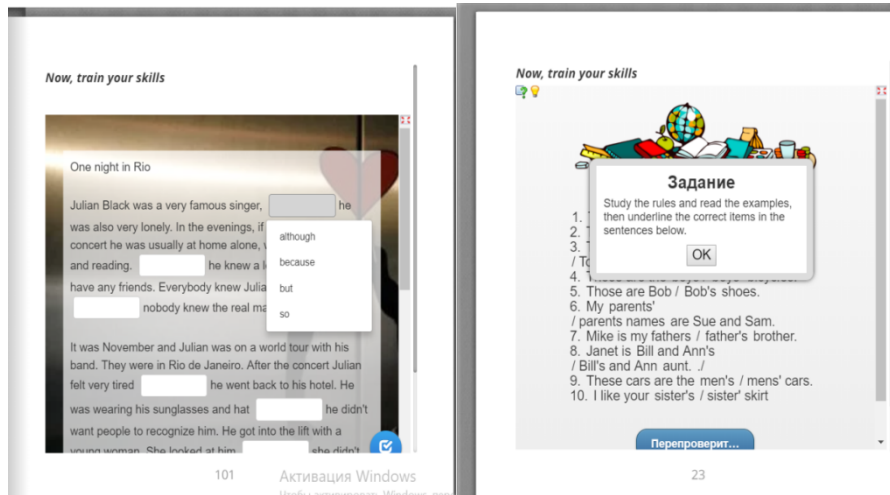


Fig. 16. Fragments of work with the interactive text



Fig. 17. Fragment of work with the video content

Summing up the depicted experience and specific example, we would emphasize the following. On condition of such an interdisciplinary preparation and project activity, pre-service teachers obtain meta-skills on the design of innovative learning aids. In the process of this kind of training, potential teachers obtain full understanding and capability for practical embodiment of core ideas of holistic educational approach via their personal experience of development of the learning aids. It will consequently raise

their motivation to the implementation of such an approach into their own professional activity with the help of the specially prepared aids.

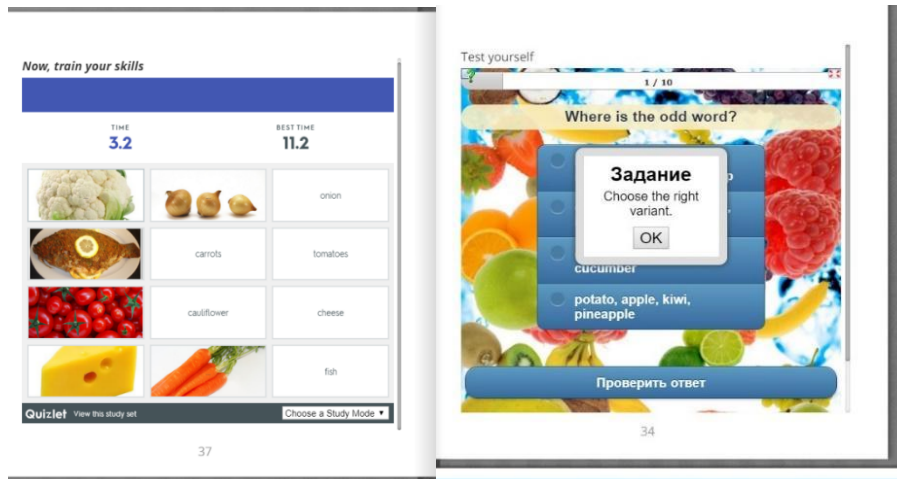


Fig. 18. Fragments of the Learning Activity Management component with repeated material and involvement of game elements

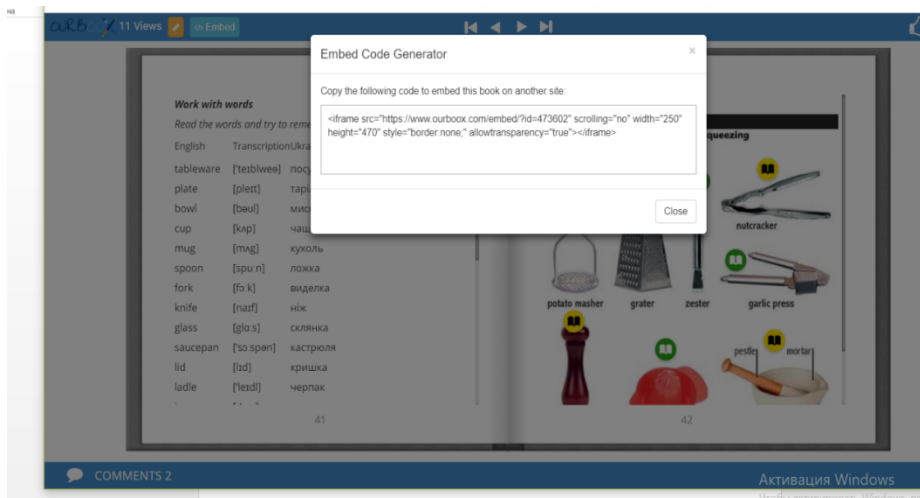


Fig. 19. A fragment of the technology component that allows you to embed the author's tutorial on other websites

It seems to be reasonable to predict positive influence of this kind of training on the forming of the students' holistic system of professional knowledge and skills. Elaboration of proper methodology of its diagnosing and estimation is a prospect of our further research.

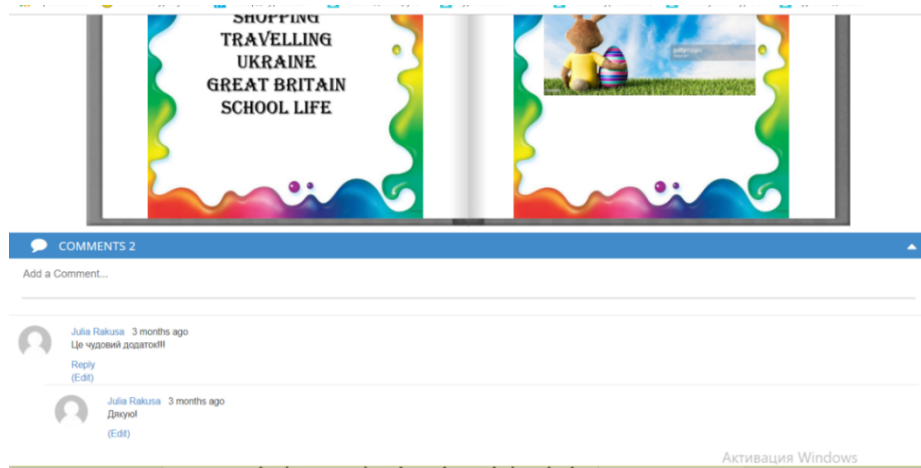


Fig. 20. Fragment of work with comments element of the tutorial for feedback realization

4 Conclusions

In accordance with its goal, the paper covers practical aspects and experience of Informatics teachers' preparation for the design of innovative learning aids as one of the important components of the renewed model of teachers' training. Theoretical background of the research includes holistic educational approach and functional basics of electronic didactic aids development. The specific example of such an experience (students' project activity on the design of English multimedia tutorial for schoolchildren) is depicted in details. The prospects of further research are outlined.

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