



Software tools for creating electronic educational resources in the resource-based learning process

Nataliia Kononets¹

Olena Ilchenko²

Valeriy Zhamardiy³

Olena Shkola⁴

Halyna Broslavska⁵

Olena Kolhan⁶

Ruslana Padalka⁷

Tetyana Kolgan⁸

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¹ Doctor of Pedagogical Sciences, Associate Professor of the Department of Pedagogy and Social Sciences of the University of Ukoopspilks «Poltava University of Economics and Trade», Poltava, Ukraine.

² Doctor of Pedagogical Sciences, Associate Professor, Professor of the Department of General Pedagogy and Andragogy, Poltava V. G. Korolenko National Pedagogical University, Poltava, Ukraine.

³ Doctor of Pedagogical Sciences, Associate Professor of the Department of Physical Education and Health, Physical Therapy, Ergotherapy with Sports Medicine and Physical Rehabilitation, Poltava State Medical University, Poltava, Ukraine.

⁴ Ph.D. in Pedagogics, Professor, Head of the Department of Physical Education, Municipal Establishment «Kharkiv Humanitarian Pedagogical Academy» of Kharkiv Regional Council, Kharkiv, Ukraine.

⁵ Ph.D. in Pedagogics, Associate Professor, Associate Professor of the Department of Mathematics and Physics, Municipal Establishment «Kharkiv Humanitarian Pedagogical Academy» of Kharkiv Regional Council, Kharkiv, Ukraine.

^{6,7} Ph.D. in Philology, Associate Professor, Associate Professor of Ukrainian Language and Literature SHEI «Donbas State Pedagogical University», Sloviansk, Ukraine.

⁸ Ph.D. in Pedagogics, Associate Professor, Dean of the Faculty for Advanced Studies of Pedagogical Staff, Associate Professor of Management Education, Donetsk Regional Institute of Postgraduate Education, Kramatorsk, Ukraine.



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Nataliia Kononets¹, Olena Ilchenko², Valeriy Zhamardiy³, Olena Shkola⁴, Halyna Broslavska⁵, Olena Kolhan⁶, Ruslana Padalka⁷, Tetyana Kolgan⁸

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Email ID: natalkapoltava7476@gmail.com, ilchenko.olena@gmail.com, Shamardi@ukr.net, alesikk1974@gmail.com, broslavska2010@gmail.com, Ovkolgan@gmail.com, ruslana-padalka@i.ua, taKolgan@ippo.dn.ua

ABSTRACT

The article provides an in-depth analysis of one of the tools for creating EER for RBL - the Dr.Explain software application. It also discusses the capabilities of users and the most effective ways to create electronic educational resources in the Dr.Explain program. The aim of the study is to suggest and compile methodological guidelines for designing and developing electronic educational resources for resource-based learning using Dr.Explain software. Dr.Explain is a program designed to create software documentation (help files), help systems, online manuals and user manuals, technical documentation for software and technical systems. The experiment involved 523 students of 1 and 4 courses of study of the specialties 017 «Physical education and sport» and of 1 courses of study 011 «Educational and Pedagogical Sciences». Among the research methods used are: theoretical (analysis, comparison, generalization); pedagogical (pedagogical experiment, pedagogical observation); social and psychological (questioning), mathematical (mathematical calculation, ranking, regression). The research revealed that Dr.Explain is a useful tool for creating CHM help files, print-ready documents, e-books, allowing the user to compile e-learning hypertext resources in two formats (PDF and HTML). An analysis of the experience of using such an EER allows us to note that it is recommended to use electronic study guides in PDF format on tablets and smartphones, and this means what students do when downloading them from the Google platform or an official representative of the university. Web site. HTML e-manuals are easy to use by installing them on classroom desktops or students' laptops. In general, these EERs (both formats) are easy to install and view, and are independent of the operating system and software.

Keywords: «resource-based learning», «information-learning environment», «electronic educational resources», «electronic study-guide», «hypertext, Dr. Explain».

INTRODUCTION

The current stage of development of digital technologies in the educational process is characterized by the development of a new information and educational environment, one of the necessary components of which is

electronic educational resources (EER). At the same time, there is a search for effective methods of developing didactic materials in digital form. Teachers of higher education institutions are actively implementing the possibilities of digital technologies in the educational process, creating a new digital didactic support for the study of disciplines. The problem of qualitative creation, development and effective use in the educational process of EER, which determines one of the areas of implementation of the concept of resource-based learning (RBL), is becoming relevant.

Nowadays electronic educational resources development process, which is already widely implemented among top countries measured by education level, appears to be an inevitable stage for ensuring and supporting a strong educational system. Ukraine is also on its way (Hurzhii et al., 2013) towards redesigning its education system, however, the efficiency and effectiveness of the changes made prove themselves to be far from desirable.

Implementation of resource-based learning as a modern didactic system established in leading countries (Austria, Australia, England, Germany, Ireland, Canada, Norway, USA, Sweden, etc.) might give a new impulse towards improvements and solve the problem of securing functioning educational resources for global learning environment. Resource-based learning (RBL) – a combination (Kononets, 2016) of formats, methods and tools for learning, aimed at developing a holistic approach when it comes to organization of the educational process, focused not only on the acquisition of knowledge and skills themselves, but also on training the ability to transform information environment effectively and independently by searching and applying information resources on practice. It is already clear that the whole shift towards such educational system at schools, colleges, higher education institutions will provide high-quality training for a mobile, competitive graduate, future specialist, able to look for and analyze information, make well thought-out decisions, thus, to live and work in today's information society. For efficient implementation of RBL for students (Hrynova et al., 2019), one should establish an information-learning environment (ILE) within higher education institutions – a pedagogical system, combining information resources, computer training tools, learning process management tools, pedagogical technologies aimed at forming an intellectually developed socially significant creative personality as a competitive specialist. As noted by (Hurzhii et al., 2013), important components of ILE are electronic educational resources among which are virtual workshops, multimedia complexes, electronic libraries, e-textbooks, reference books, etc.

RBL as a modern field of study at schools, colleges, higher education institutions, are actively considered and explored by numerous foreign researchers – (Hill et al., 2001; Maharg et al., 2002; Chang, 2007; Böhnstedt et al., 2009; Butler, 2011; Wijaya, 2019) and others, especially focusing on the role of electronic educational (learning) resources in the learning process and multimedia tools which promote voluntary self-directed, lifelong learning. That is the reason why design and development of electronic educational resources as RBL tools is especially relevant today in terms of a wide variety of modern software applications. The term «electronic educational resource» (EER) implies logically complete set of teaching and learning support materials (theoretical information, task samples and problem solving examples, list of tasks that require further discussion, computer testing, etc.) presented in e-form (as a file) or uniform resource identifier (URL). EER include electronic textbooks and tutorials, guides and encyclopedias, multimedia courses, computer simulators, workshops and laboratories, educational-methodical complexes, lecture notes, electronic versions of full-text study guides, electronic versions of full-text scientific and methodological publications used in the learning process, virtual science labs and business simulation games. The main goals (Böhnstedt et al., 2009) for development of EER as vital RBL tools are modernization of existing education system, arranging information content within learning environment, ensuring equal access to quality teaching and learning materials based on modern information and communication technologies for everyone who is involved in the educational process regardless of their place of residence and form of study.

A number of researchers provide various papers and thesis on design and use of EER among whom are (Hill et al., 2001; Maharg et al., 2002; Hadjerrouit, 2005; Semerikov et al., 2012; Hurzhii et al., 2013; Kononets, 2015; Novopysmennyi et al., 2020; Kononets et al., 2020) and others. Above mentioned scholars have defined the concept, requirements for content and structure, main principles of EER creation. Thus, for this purpose, there is a wide range of software applications with different degrees of complexity available.

The research of Ukrainian and foreign scientists elucidates the theoretical, methodological, technological and practical aspects of quality assurance of the educational process (resource-oriented learning, distance learning) using electronic learning resources and others. Various aspects of this issue have been studied in the works of the following scientists:

- analysis of the functionality of Constructor Electronic books (Kononets et al., 2020), SunRav BookOffice, Webnode software products for the possibility of their use in the process of creating electronic learning resources;
- research of web bases (Hadjerrouit, 2005) of virtual learning, methods of technology-oriented or online learning;
- research of models of introduction (Hill et al., 2001) of electronic resources in educational process;
- coverage of issues (Hurzhii et al., 2013) of classification of electronic teaching aids, pedagogical software,

electronic textbooks, their structure and content; theoretical and practical principles of designing electronic textbooks for school;

- design of open learning environment (Kononets, 2016; Kononets et al., 2020) of the university and practical aspects of development of local and open electronic educational resources for resource-oriented learning of students;

- theoretical and methodological foundations (Semerikov et al., 2012) of blended learning, methods of improving the process of independent work of students using electronic learning resources;

- design of resource-oriented (Maharg et al., 2002) educational process using Internet resources and modern information and communication technologies;

- methods of developing electronic manuals (Novopysmennyi et al., 2020) in Microsoft Front Page and others.

At the same time, the problem of resource-oriented education of high school students is not solved completely. Need to address the issue of finding and finding software tools for creating electronic learning resources in the process of resource-oriented learning of students receiving pedagogical education. The problem of high-quality didactic support of the learning process of students studying the disciplines of the pedagogical cycle remains relevant and requires an urgent solution. Therefore, it is necessary to create a methodology for the development of such electronic textbooks in pedagogical disciplines, which will be available to students from any modern computer and mobile devices.

MATERIALS AND METHODS

The aim of the study is to suggest and compile methodological guidelines for designing and developing electronic educational resources for resource-based learning using Dr.Explain software.

The study materials were collected during March 2020 and February 2021 and included data on the level of professional preparation students. The experiment involved 523 students of 1 and 4 courses of study of the specialties 017 «Physical education and sport» and of 1 courses of study 011 «Educational and Pedagogical Sciences» in Municipal Establishment «Kharkiv Humanitarian Pedagogical Academy» of Kharkiv Regional Council, Poltava V. G. Korolenko National Pedagogical University, Poltava State Medical University and SHEI «Donbas State Pedagogical University».

Among the research methods used in the experiment are the following:

- 1) theoretical (analysis, comparison of data from psychological, pedagogical, socio-pedagogical literature and periodicals, study of documentation on the organization of the educational process of the university, generalization and systematization of research results);
- 2) empirical (questionnaires, pedagogical experiment, pedagogical observation, online testing);
- 3) socio-psychological (survey),
- 4) statistical processing of experimental data (mathematical calculation, ranking, regression).

RESULTS AND DISCUSSION

Dr.Explain software is a tool for creating software documentation (*help-files*), help systems, on-line user guides and manuals, technical documentation for software and technical systems. Practical experience indicates that *Dr.Explain* a useful tool for creating CHM help files, ready-to-print documents, e-books, allowing the user to compile hypertext EER. Some special features of *Dr.Explain* are application windows capturing, screenshot editing and formatting, using visual effects and styles, etc. Interface and application's window capture technology analysis allows automatic application or website interface recognition, all significant control elements capture: buttons, menus, toolbars, edit fields, and then arrange screenshot annotations.

Built-in annotation editor is used to manually enter screenshot description, use text formatting tools, insert, if necessary, some symbols such as an arrow, etc. Likewise, the program allows to remove selected text from where it has been moved using copy and paste key commands. This feature might be of great help when designing and developing EER for computing disciplines since it is often necessary to use screenshots of various software applications to teach creating interface descriptions while having lectures and workshops on these subjects. *Dr. Explain* supports documentation output based on a standalone project into such formats as *HTML* (on-line guides and manuals), *CHM* (*help-files* for *MS Windows*), *RTF* and *PDF* with contents and references. The operating principles, features and special tools of the program being considered are described in more detail by (Besedovskiy et al., 2012). Summarizing the above-mentioned publications, we can state that the main advantages of *Dr.Explain* software for a teacher who is developing EER are:

- Integrated into Dr. Explain window capturing utility that analyzes the internal structure of captured windows, allowing to analyze the user interface and take screenshots (screen captures) of windows, automatically creating annotated screenshots with various callouts.
- Screenshot annotation editing tool that make editing a quick and effortless by creating callouts for images and screenshots.
- Special text editor toolbar which supports a wide range of functions.
- Flexible content management feature using text variables and *HTML*-code inserts.

- Ability to quickly update illustrations and screenshots upon new software version release.
- *Dr.Explain* allows to replace application screens with all available metadata: callouts, annotations, captures.
- *Help ID* support to create the context help within applications.
- Ability to add search and index functions in *on-line* manuals without programming (*PHP, ASP* и т. д.) and server-side databases.
- Visual project status monitoring and progress tracking using the status bar.

As shown, *Dr.Explain* software features prove themselves to be convenient and efficient for developing various EER, starting from e-lecture notes and text-books to full-fledged electronic teaching and learning materials and educational online resources. It is available to download and install on the website <http://www.drexplain.ru/>. Upon effortless downloading and installation of the application, a window «**Dr.Explain Projects**» should appear. Use this dialog to select: create a blank project file, import an existing document, or open recently modified project. All projects are saved with *GUI* file extension. The project main window is as shown in Figure 1.

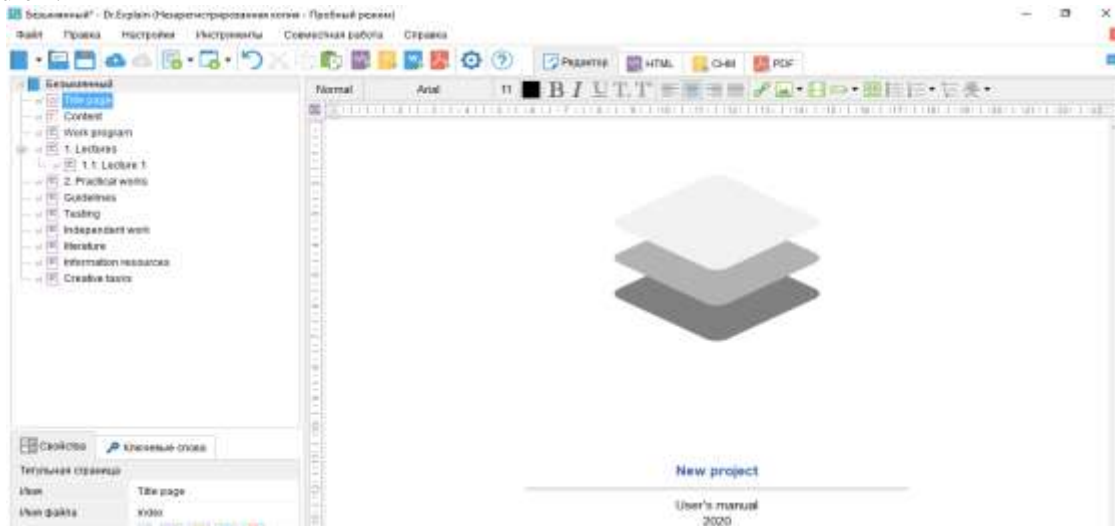


Fig.1: Dr. Explain Application Main Window

The main window of *Dr.Explain* allows to create new projects, add new elements and manage application options, project settings, etc. Upon creating a new project, one may simply implement a designed structure, such as for an e-textbook or a laboratory workshop guide, using the toolbar (see on the left in Fig. 2), called Project Tree, and the regular context menu.

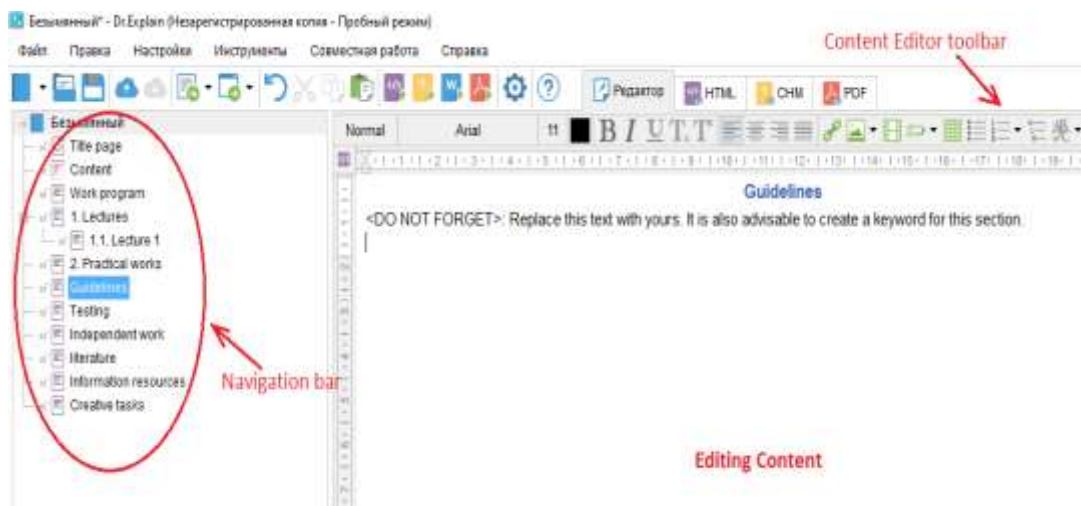


Fig.2: Designing Electronic Educational Resource Structure

Inserting educational content into project pages is relatively simple: *Ctrl+C* / *Ctrl+V*. Therefore, it might be better to first edit text materials in *Microsoft Word*, so as not to make any significant changes, otherwise it will turn into hypertext. We would like to point out that, as a matter of convenience, it is reasonable to prepare each lecture (topic), each workshop, each structural element of materials for any EER project in a separate *Microsoft Word* file. Multimedia components should also be saved into separate files.

Editing function is carried out through a special **Editing Content** tool – the main program workspace which enables topic content editing. This may include bitmaps, texts, links, annotated screenshots, titles, tables, and various objects that can be added via the editor toolbar (Fig. 2). The spell check function is also available. Double-click any object to edit its properties. If you work with an annotated screenshot, you can manage its references and numbered tags by double-clicking the image to proceed to Designer mode.

When creating their own EER (Wilson, 2012), the teacher acts as a content curator who performs the following functions: optimizing learning materials; editing titles; formatting the content; selecting and adding appropriate images; inserting comments on the text materials for ensuring better understanding; adding customized introduction; integrating links and references; working with multiple primary sources; looking for new relevant content and new sources; advising and providing crowdsourcing information; encouraging experience sharing with others. Content curation is performed in three stages: research (information gathering and assessment), relevance and context (information analysis), insight (defining unique information and predictability).

The **Import external files** function may also come in handy when designing EER. All types of supported file formats that can be imported to *Dr.Explain* are listed below: *Compiled HTML Help (CHM)* file; folder with files (*html, txt, xml*); standalone *HTML* file; *HLP* file; *RTF* file; *Microsoft Word* file.

To bring up this function, go to **Settings – Import from external files**. The first step is to select the corresponding file type. The second step is to match the document formatting styles. The **RTF Document Styles** list shows all document styles found in the selected RTF document. The **Topic Nesting Levels** list displays all available topic nesting levels. It might be useful to use move buttons to move the selected style from one list to another. Document Style Preview shows the preview of the selected document style and the font settings, displays the preview of the selected nesting level style and font settings. If you clear '**Do not consider page break as topic's end**' check box, *Dr.Explain* will consider each page break in the specified RTF document as a topic's end. The third step is the process of importing itself, after which the imported topic appears in the **Topic Tree**.

One of the most useful tools of *Dr.Explain* software in terms of compiling EER for computing disciplines is capturing screenshots function, allowing to analyze the internal structure of captured windows and automatically recognize application controls. *Dr.Explain* creates linked references for each control element, thus, you just need to add descriptions where necessary. This semi-automatic method saves a lot of time when you need to add an annotated screenshot to illustrate the windows of software applications included in the syllabus.

To add a new screenshot into an existing project, select the sibling node in Project Tree and press Capture in the main toolbar. Once you select this option, **Capture an object** dialog appears for capturing snapshots, and add it along with its controls to the project. To capture the window, move the mouse to select: press *Print Screen*, hold down the *Ctrl* key while you left click on the window, mouse both keys pressed, press "Snapshot" in the window.

In **Capture an object** dialog, **Capturing** check box shows which objects are available for capture when the mouse points to them, these include: *Java Swing GUI* controls (highest priority); *HTML* tags in *MS Internet Explorer*; accessible objects; *Win32* window controls (lower priority).

If you need to exclude unnecessary objects from selection and capture, clear all check boxes.

Click **Capture** button to create a screenshot. This is one of four ways to capture a selected object. After capturing the object, it is being recognized and analyzed, and then the program automatically creates an annotated screen topic. Double-click the screenshot image to edit the created screenshot in **Designer mode**.

It is necessary to add *controls* to the captured screenshot. Controls are functional elements of the captured window, including buttons, edit fields, drop-down lists, checkboxes, etc. *Dr.Explain* automatically recognizes controls while capturing a screenshot and creates annotated callouts for them. There are two control states: visible (active) and invisible (inactive). Visible controls are displayed in the picture as numbered callouts and are listed in the main contents of the topic. Each control is assigned to a rectangular area in the screenshot. EER developer may rearrange the controls, update their properties and setup their visual settings.

To manage screenshot controls and their numbering switch to **Designer mode** – a special tool for working with screenshot annotations. Annotation designer toolbar allows to operate with screenshots and controls and customize the designer workspace. Designer workspace also allows to rearrange and change control number by simply clicking and dragging. Thus, to adjust the size of control areas and screenshot image itself.

Designer tool tabs (left part of the window) allow to switch between different tools in designer window: **Designer**, **Control areas management** and **Screenshot editing**.

Functional modes overlap, each of them is focused on different aspects of control and screenshot management. **Control Properties** are located at the bottom of the window. This panel provides access to properties of the selected control. Its structure is very similar to the structure of topic settings.

It might be of great use to configure the settings for the current project brought up by clicking **Settings – Project Settings** menu option. In Project Settings it is reasonable to configure the following options: screen capturing, screenshot annotating, list and formatting styles, publishing *on-line*, etc. A key feature of the software in terms of EER design and development is the feature of saving and presenting e-resources in two formats:

PDF and HTML. To create an EER in PDF format, open **Settings – PDF Export** in the appearing dialog window, press **Start Export**.

Fig. 3, 4 show the examples of EER – electronic study guides for «Personalities in historical and pedagogical discourse» and «Comparative Pedagogy of Higher Education» disciplines, which constitute the hypertext environment of PDF file format. It uses navigation bar, hyperlinks, automatic table of contents and scrollbars to view pages.

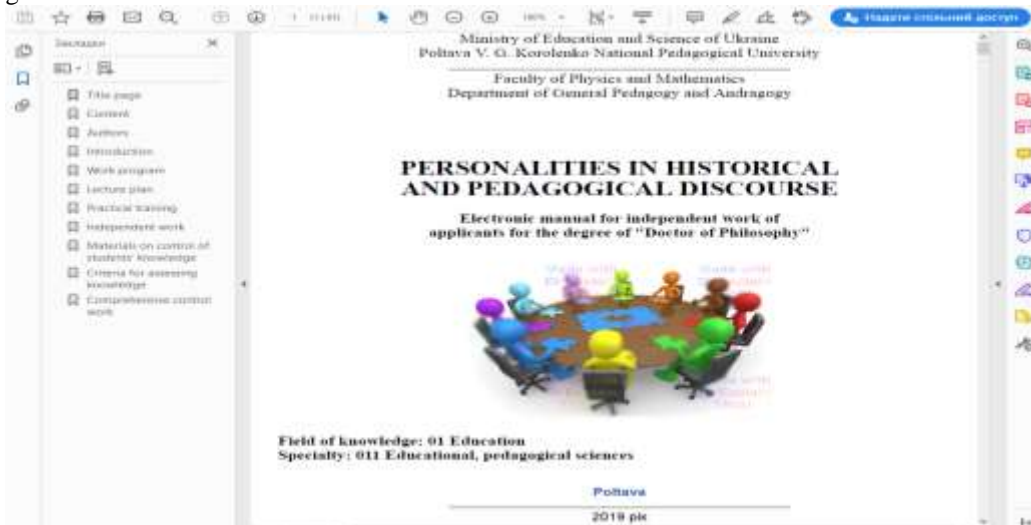


Fig.3: «Personalities in historical and pedagogical discourse» Electronic Study-guide in PDF file format

The disciplines «Personalities in historical and pedagogical discourse» and «Comparative Pedagogy of Higher Education» were included in the syllabus in 2019-2020 academic year for postgraduate students in Poltava V. G. Korolenko National Pedagogical University in specialty 011 «Educational and Pedagogical Sciences».

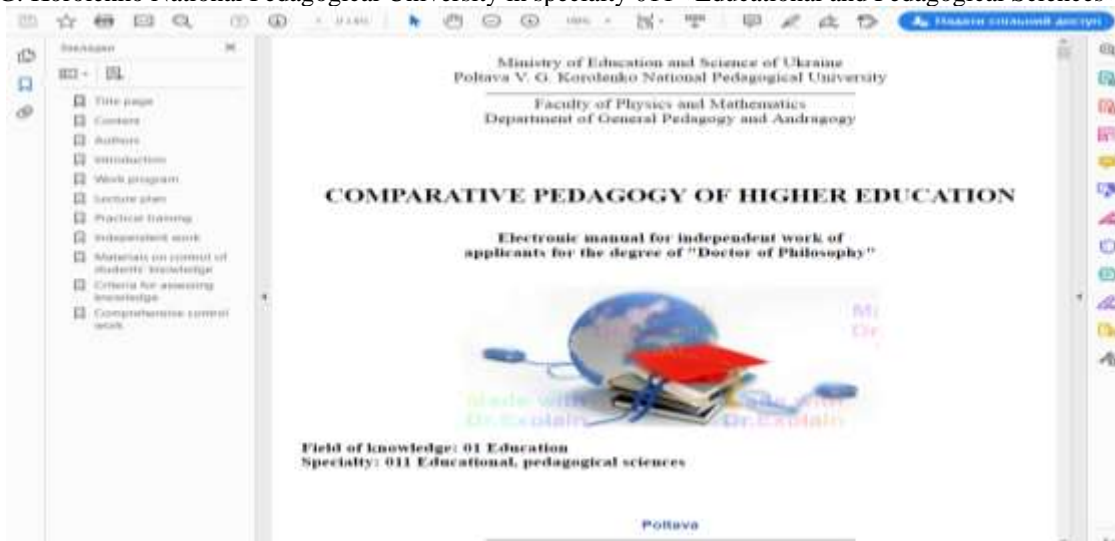


Fig.4: «Comparative Pedagogy of Higher Education» Electronic Study-guide in PDF file format

There was conducted a postgraduate student survey that preceded EER design and development. Before launching «Personalities in historical and pedagogical discourse» and «Comparative Pedagogy of Higher Education» disciplines, postgraduate students were asked to answer the following questions: Which format do you consider best for presenting information (printed or electronic)? How often do you use electronic study-guides when preparing for a class? How often do you use printed publications when preparing for a class? To what extent, in your opinion, your higher education institution library is supplied with print editions? In your opinion, will the use of electronic study-guides improve your learning outcomes? What do you think are the benefits of using electronic study-guides? What challenges might you face when it comes to using electronic study-guides?

The results of the survey showed that the vast majority of postgraduate students is inclined to believe that using electronic study guides is more reasonable than print ones. Among the benefits of using electronic study guides

are the following: mobility, convenience and flexibility, the ability to interact with the teacher at any convenient time, equal access to learning materials, opportunity to learn for persons with disabilities, increase the knowledge level of graduates, easy sharing of learning materials among users, development of self-study skills, encouraging learning motivation desire for lifelong learning and so on. Thus, based on the student survey mentioned above and considering modern conditions for higher education redesign process, priority and importance of self-study work in terms of educational process, the following electronic study guides were developed: «Personalities in historical and pedagogical discourse» and «Comparative Pedagogy of Higher Education». Content author and lecturer – O. Ilchenko; creator of electronic study guides – N. Kononets.

The table of contents of an electronic study-guide includes: 1) introduction; 2) discipline syllabus; 3) annotated lecture notes; 4) methodical guidelines (recommendations) for conducting practical (seminar) classes, self-study; 5) assessment materials (current, semester, module assessment); 6) criteria for evaluating the educational achievements of applicants; 7) instructional and methodological materials for complex assessment.

It should be mentioned that the *Table of Contents* page of an e-guide in *PDF* format is inserted automatically by displaying automatic table of contents, including hyperlinks and page numbering. In case you need to create your own hyperlinks on topic pages, use **Link** button located in Editing Content toolbar. Using the appearing dialog, we may link the selected text to an external Internet address (URL) or a specific element in the project, or delete all unnecessary links. As is commonly known, to view an online guide in the *PDF* format, it is highly recommended to use one of the listed programs: *Adobe Acrobat*, *Adobe Reader*, *PDFMaster*. These applications may be easily installed on any computer, laptop, netbook, tablet or smartphone, making the learning process accessible to any student, anywhere, anytime, from any device. To save an EER in *HTML* format (Hrynova et al., 2019), we should remember that such EER is a web node (a folder) - a set of files combined through *Dr.Explain* software application, created on the basis of scientific principles, open architecture, learning goals trinity, interactivity, multimedia, hypertext, semantically correct web document, individual approach and animation.

In order to create EER in *HTML* format go to **Settings – HTML Export** and click **Start Export** in the appearing window. To view the electronic study-guide in *HTML* format and use it efficiently, copy the guide folder to your computer disk, find the file called *index.html* and run it through a browser. We emphasize that this electronic study-guide (see Fig. 5) runs effectively and fully in any modern browser: *Internet Explorer*, *Google Chrome*, *Opera*, *Mozilla Firefox*, *Yandex.Browser*, etc. From the main window, a student may navigate to any section and chapter of the e-study guide (Fig. 5).

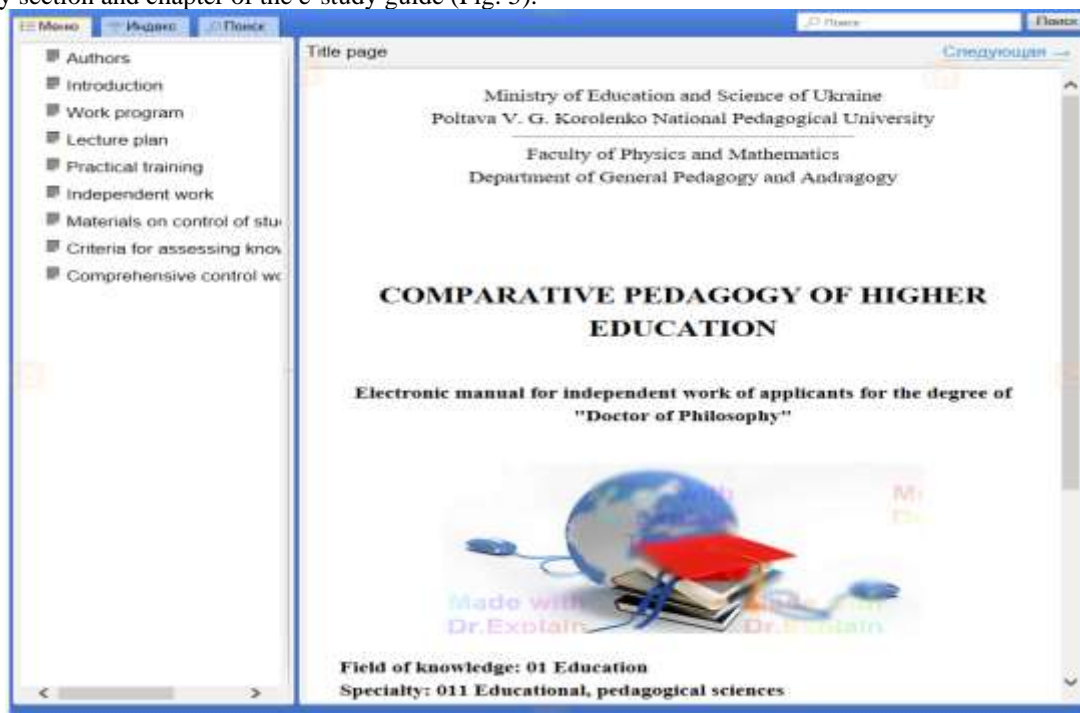


Fig.5: Electronic Study-guide in HTML format

All components of the EER are interconnected, which allows you to return to the main window or the previous page of the discipline text at any stage of learning. Moreover, it is possible to conduct a full-text search and print the e-guide using any printer (the easiest way is to switch to *PDF* format). It should be noted that *Dr.Explain* software enables effortless hyperlink creation. To sum up, the described *Dr.Explain* toolkit enables the creation of hypertext EER that meet all basic requirements: ease of creation and use, learning material availability, low system requirements.

Designing EER in these two formats completely solves the problem of its usage on different types of modern computer devices: on desktop computers, laptops, netbooks, *Apple* tablets, smartphones, *iPhone*, etc. At the Department of Pedagogical Skills and Management named after I. A. Zyazyun, the authors N. Kononets and M. Grynova developed an electronic manual «Competence approach in training» (Fig. 6).

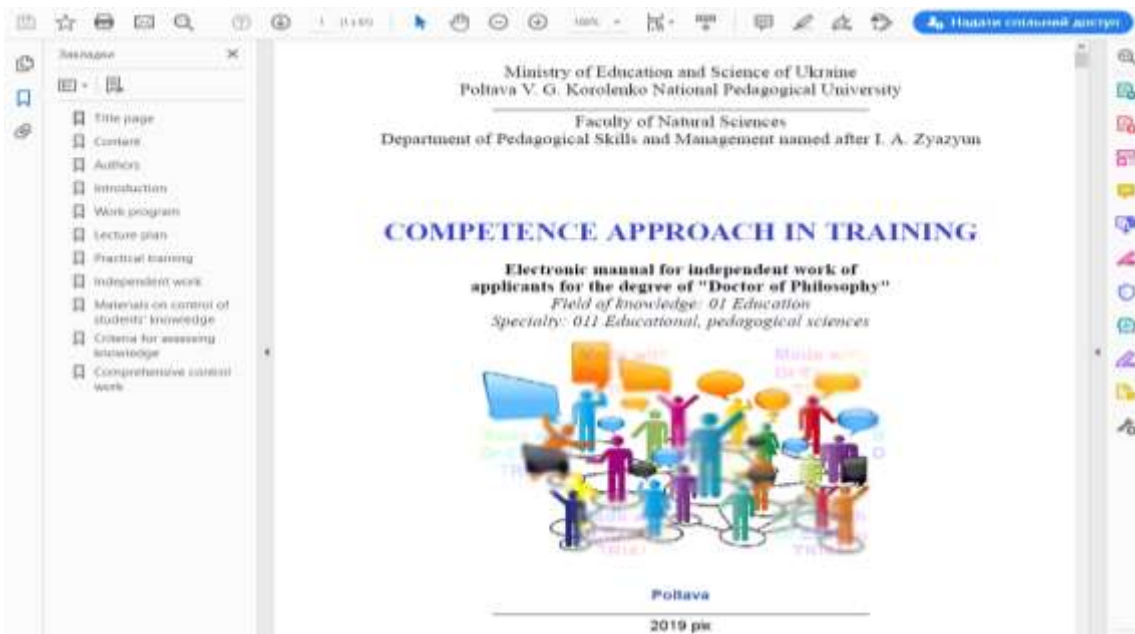


Fig.6: «Competence approach in training» Electronic Study-guide in PDF file format

Implementing RBL for postgraduate students (third level of higher education), using electronic study-guides within «Personalities in historical and pedagogical discourse», «Comparative Pedagogy of Higher Education» and «Competence approach in training» discipline syllabus is being conducted in terms of traditional educational process (full-time, correspondence form), regardless of location: a) in class according to the schedule, developed by the Postgraduate and Doctoral Studies Department and approved by the administration of the university; b) in extracurricular work (on the way home, between classes, in libraries and reading rooms, in internet cafes, etc.). The following hardware devices (Semerikov et al., 2012), are used for the organization of training: telephones - ordinary mobile phones, smartphones; PCs - laptops, portable handheld devices and tablet PCs. The above-mentioned devices use wireless Wi-Fi or mobile Internet connection from major Ukrainian mobile services providers. The use of mobile devices and the Internet for student training, regardless of the location, establishes the concept of mobile learning which we consider to be one of the areas of implementation of RBL in higher education institutions. Post-graduate students have access to online study-guides for disciplines «Personalities in historical and pedagogical discourse» and «Comparative Pedagogy of Higher Education» self-study is conducted via university Google platform (via Google Drive), that displays, by academic years, educational-methodical complex of disciplines in specialty 017 «Physical education and sport» and 011 «Educational and Pedagogical Sciences». Access to the platform is open to students as well as for discipline lecturers. Electronic study guides may also be found в Mykhaylo Zhovtobryukh institutional repository of Scientific Library of Poltava V. G. Korolenko National Pedagogical University at dspace.pnpu.edu.ua. Thus, students have the opportunity to be well-informed in advance regarding the course, its objectives and tasks, competences and learning outcomes; to find out about the amount of credits of discipline, the number of hours allocated for lectures, practical classes, self-study work; to get acquainted with the methodical instructions for conducting practical classes and self-study work, knowledge assessment and criteria for evaluating students` educational achievements and so on. At the beginning of the first lecture, the lecturer is obliged to give introductory instruction on how to work with electronic study-guides, mobile learning opportunities and benefits.

CONCLUSION

In terms of e-guide content development for the disciplines «Personalities in historical and pedagogical discourse», «Comparative Pedagogy of Higher Education» and «Competence approach in training», the authors put great emphasis on self-study work which covers both in-class and extracurricular training. *In-class* training based on electronic study-guides involves: *when preparing for lectures* - be informed of the next topic, its objectives, basic concepts, basic lecture questions, its annotated content and references used by the teacher. This allows the students to become more aware of the content of the lecture, to think through questions they would

like to ask teacher and other students, to discuss issues together, and so on. It also matters to teachers, as it turns passive listeners to involved and motivated learners which allows to co-create lectures by means of collaboration, encourage teacher-student interaction. Using e-guides *when preparing for practical classes* is aimed at: students awareness of the topic and the main issues for further discussion; solving difficult problems and practical tasks; overview of the topics of reports and abstracts to select for future defense; getting familiar with basic and additional references when preparing for practical trainings and summarizing primary sources. Not only does this motivate students to prepare for the class, it also allows them to do it in their own mode at any convenient time. In this case, the teacher acts as a mentor, consultant who helps, conducts assessment, evaluates the progress. According to the curriculum, performing *self-study tasks* (according to each topic of the content module), 66 hours out of 90 hours in total, involves: taking notes on the relevant topic in accordance with the plan based on scientific sources self-study; compiling a glossary; developing a structure-logical scheme of the topic, etc.

The main goal of EER usage is, first and foremost, to make learning materials available on all mobile devices used individually or in groups. The tasks are clearly set and must be completed by the students either during or after the class.

Regarding the experience of using such EER, we would like to point out that it is advisable to use electronic study-guides in *PDF* format on tablets and smartphones, and that is to say what students do when downloading it from the Google platform or university official website. E-guides in HTML format are easy to use by installing it on desktop computers in classrooms or on student laptops. In general, such EERs (both formats) are easy to install and view, and do not depend on operating system and software. All you need is a browser or a *PDF viewer*, which in its turn, is free and easy to install on modern computer devices of any kind. Thus, developing and design of their own EER by teaching staff, their placement and promotion on the Internet, encourages building a strong information-learning environment of an education institution, thereby shapes the learning approach based on personal knowledge networks. Combining EER (Böhnstedt et al., 2009; Kononets, 2016), making connections between them makes it possible to build a virtual community network, support knowledge sharing, allow educators to cope with multiple resources. We see further research prospects in reviewing and analyzing other modern software applications that may be adapted to create EER as a modern resource-based learning tool.

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