

# The usage of augmented reality technologies in professional training of future teachers of Ukrainian language and literature

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## Abstract

The article deals with the peculiarities of creation and practical application of augmented reality (AR) technologies for the organization of students-philologists' individual and group work in studying the discipline "Methodic of teaching literature". The relevance of the introduction of AR technologies for the future teachers-philologists' readiness formation to the professional activity is substantiated. Analysis of the scientific sources suggested that the professional training process requires the modernization of teaching methods, and the usage of information and communication technologies (ICT) in education, in particular AR technologies, allows to make the learning process interesting and exciting. The domestic and foreign experience of AR technologies application into current educational practices is generalized. A step-by-step algorithm for creating the AR in the mobile application Unite and its subsequent content filling for professional training of future teachers of Ukrainian language and literature is described. The visualization of the educational content of the lepbook "Incredible Lesya Ukrainka", made by students-philologists at the Mykhailo Stelmakh Faculty of Philology and Journalism of Vinnytsia Mykhailo Kotsiubynskyi State Pedagogical University during the studying the discipline "Methodic of teaching literature", is detailed. It is specified that the educational process is based on the creation AR with the visualization of interactive learning materials with animation, instructions, links, video content, illustrations etc. according to the rubrics of the lepbook. It is emphasized that the implementation of AR technologies provides the increasing of motivation for systematic mastering of practical skills, enhances students' concentration and attention, increases their cognitive experience, promotes the development of their creative abilities, produces the opportunities of using the visualized content for students' research work, stimulates them to self-expression, motivates them to self-development, trains them to the skillful use of the Internet, modern gadgets and mobile applications, etc. Prospects for studying the possibilities of using AR technologies in lessons of Ukrainian literature at secondary school are determined.

## Keywords

augmented reality technologies, professional training, the future teachers-philologists, mobile applications, visualization, digitalization

# 1. Introduction

## 1.1. Problem statement

High-speed information progress of society, the creation of new means of processing, transmission, reception and storage of information cause the new challenges to the educational modernization. Today such ICT as virtual and augmented reality are gaining wide popularity in professional training of future professionals in higher education. The linguistic and literary field is no exception [1]. AR technologies are used in the format of mobile learning and are a powerful tool for improving the digital competence of future teachers of Ukrainian language and literature.

The usage of AR technologies helps to combine physical and digital visualized content to reproduce the effect of maximum reality, adds the appropriate visual information, implements students' interaction with virtual projection in real time. The introduction of AR technologies in the educational process of future teachers-philologists provides the increasing of motivation for systematic mastering of practical skills, enhances students' concentration and attention, increases their cognitive experience, promotes the development of their creative abilities, produces the opportunities of using the visualized content for students' scientific research work.

Thus, AR technologies become more often used in different social activity fields and especially in education. A lot of educational AR applications in biology [2], physics [3], chemistry [4], natural science [5], mathematics [6], history [7] and other subjects have been developed, and even AR books for children have been created [8]. However, the usage of AR technologies in professional training of the future teachers of Ukrainian language and literature still remains unexplored.

## 1.2. Literature review

Milgram et al. [9] discussed AR displays in a general sense, within the context of a Reality-Virtuality continuum, encompassing a large class of "Mixed Reality" displays, which also includes Augmented Virtuality. According to Milgram and Kishino [10], AR is characterized as a specific innovative technology based on the display of an otherwise real environment is augmented by means of virtual (computer graphic) objects.

Azuma [11] provided a starting point for anyone interested in AR in his survey. He defined

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AR as a variation of Virtual Reality (VR). AR allows the user to see the real world, with virtual objects superimposed upon or composited with the real world. Azuma [11] convinces that AR supplements reality, rather than completely replacing it, because the virtual and real objects coexist in the same space.

Different aspects of the implementation of AR technologies in the educational process attract was studied by Babkin et al. [12], Burov et al. [13], Gargrish et al. [14], Jerabek et al. [15], Kaur et al. [16], Kiv et al. [17], Kolomoiets and Kassim [18], Kramarenko et al. [19], Lavrentieva et al. [20, 21], Nechypurenko et al. [22], Palamar et al. [23], Panchenko et al. [24], Pochtoviuk et al. [25], Rashevskaya and Soloviev [26], Rashevskaya et al. [27], Scaravetti and Doroszewski [28], Shepiliev et al. [29], Semerikov et al. [30], Striuk et al. [31], Tarasenko et al. [32, 1], Tkachuk et al. [33], Tuli and Mantri [34], Vakaliuk and Pochtoviuk [35], Zelinska et al. [36], Zhou et al. [37], Zinonos et al. [38] and others. According to many researchers [39], AR technologies are one of the trends in modern education, which allows to modernize the learning process in the context of digitalization.

A considerable amount of research papers has been investigating the effectiveness of AR in education, aiming to improve traditional methodic of teaching [40, 41, 42]. Ramirez et al. [43] researched the benefits of the use of AR on the area of maintenance and education. They discovered that the transfer of knowledge using AR is faster than the traditional methods, thus AR technologies help to train the specialists faster and better.

The use of AR technologies in the studying of Ukrainian language and literature remains poorly understood. For example, Nezhyva et al. [44] substantiated the prospect of the usage of AR within the linguistic and literary field of primary education. But the usage of AR technologies in the formation of the readiness of future teachers of Ukrainian language and literature to professional activities has not been studied.

Despite the interest of scientists in modernizing teaching methods, the problem of using ICT, in particular AR applications, in formation the readiness of future teachers-philologists for professional activity requires further researches. The analysis of scientific publications proves that the AR applications in the educational process have limited and insufficient use, and the observations of practical implementation show that a small number of teachers use them expediently and effectively in their work. Therefore, in accordance with the needs of modern society in intensifying the use of ICT for educational purposes, it is important to study methodologically and pedagogically appropriate ways of effective training of students-philologists with the help of AR.

### **1.3. The aim of the research**

The aim of the research is to elucidate the peculiarities of the creation and use of the AR technologies in the format of studying the discipline “Methodic of teaching literature” for effective professional training of students-philologists.

## 2. Discussion and results

### 2.1. AR technologies in education: the experience described in research papers

According to Scaravetti and Doroszewski [28] with the help of AR the student is in a learning by action position. Thus, the student can be more involved and build his/her knowledge in real life situations. The researchers noticed a strong interest of learners in the use of AR, and the biggest students' interest in AR is to bring the targeted information at the appropriate moment.

Gargrish et al. [14] substantiate their choice AR over VR for the purpose of education as AR provides the learner's interact with real objects aside from immersion and interaction with virtual objects feel. The authors list different devices for experiencing AR, it can be mobile based, desktop based or tabletop environment.

Kesim and Ozarslan [45] describe the combination of AR technology with the educational content as a new type of automated applications that acts to enhance the effectiveness and attractiveness of teaching and learning for students in real life scenarios. The authors note that displaying information by using virtual effects that the learner cannot directly detect with his own senses can enable a person to interact with the real world in ways never before possible. They affirm that the position, shape, and/or other graphical features of virtual objects can be changed with interaction techniques AR supports. The researchers underline that information conveyed by the virtual objects helps students perform real world tasks. One more important statement is that AR textbooks can be used in educational process and become dynamic sources of information [45].

Coimbra et al. [46] highlight the need to implement AR in education because it can encourage motivation, comprehension and a higher involvement with the contents to be learned. Thus, AR technologies may increase the use of information and the access to knowledge, improving digital and info-inclusion. Besides such technologies allow the integration of theoretical knowledge in real contexts and also allow the integration of real contexts in more theoretical ways of presentation [46].

Zhou et al. [37] consider AR as promising potential tools for science teaching and learning processes that could foster positive emotions, motivate autonomous learning, and improve learning outcomes. The researchers note that mobile AR-assisted learning is flexible for students to use pre-class or after-school without being constrained by time and space, it helps students to learn the theoretical aspects of subject. The authors point out that AR can improve learning efficiency and prompt positive emotions. They differentiate AR technologies used in science education into 2 categories: image-based AR and location-based AR. Scholars draw our attention to image-based AR (including marker and markerless technology) which promote to develop the students' spatial abilities, practical skills, and their understanding of concepts through real-time interactive simulation experiments. The authors distinguish AR book as one of the most common image-based AR technologies in education [37].

Jerabek et al. [15] detailed the didactic aspect of AR in such a way that the students find themselves in an environment that is deliberately designed to provide the appropriate conditions to fulfill the educational purpose. The researchers sum up the main educational functions which are basics to all didactic situations with the usage of AR. Firstly, it's the adjusting the degree of

emotional impact of the resulting AR environment, and, secondly, cognitive load adjustment. The authors aver that these functions predetermine the usage of AR in education in many different forms and in various ways to achieve the following five principal educational purposes:

1. Increase in information value.
2. Exposition of temporally and spatially heterogeneous phenomena.
3. Simulation of phenomena, events and processes.
4. Acquisition and building of competencies in model situations.
5. Management activities [15].

Jerabek et al. [15] assure that AR is an innovative didactical tool which contributes to a more effective and better-quality education activities through enhancing the system of didactic tools and their functions and become thus a suitable tool for supporting cognitive processes in various educational fields.

Kaur et al. [16] draw our attention to AR which provide the students with such tools that they are able to visualize and interact with what is taught in the classroom. Thus, their motivation towards learning can be enhanced with the help of AR technologies which, in their turn, have an edge over the traditional styles of teaching and learning in classroom settings.

Bacca et al. [47] mention the special situation in Vocational Education and Training (VET) institutions where teachers face important difficulties in the teaching process due to a wide variety of student's special educational needs as well as student's lack of: the adequate level of basic competence, motivation, concentration, attention, confidence and background knowledge, among other aspects. The authors report positive impact of mobile AR applications in VET for increasing motivation, especially in confidence and satisfaction dimensions. The research has provided insights on how AR can be used to support the three main guidelines of the Universal Design for Learning: a) provide multiple means of presentation b) provide multiple means of expression and c) provide multiple means of engagement. Thus, AR applications can be designed to address special educational needs of students in VET institutions [47].

Several researchers emphasize that AR technologies offer a major opportunity to revolutionize education and to promote student-centered learning [48, 49, 50, 51, 52]. They proclaim AR technologies empower the future of education, because AR helps facilitate the learning process, enhance current online education methods, bridge the gap between formal education and informal learning, and equip educators with novel methods of content delivery.

Nincarean et al. [53] sums up that most of the students (who had never experienced an AR) felt motivated using AR technologies application in their studying, enjoyed the process of scanning and finding virtual effects in real time, and achieve high levels of engagement in learning performance.

AR technologies implementation in education is just beginning to be explored, especially when using it with preschoolers. Cascales et al. [54] define AR as one of the most interesting emergent technologies for education, being a powerful and motivating tool which can involve several senses of the student by means of the proper combination of sound, sight and touch. In their paper the researchers attempted to track the likely linkage between parental influences and children's use of ICT, specifically AR, for educational purposes. The authors outline that the parents whose children have worked with AR are more satisfied with the results achieved

by their kids that those parents whose children have not worked with AR, although both groups have used the same educational system. According to the survey, the parents were very satisfied with the use of AR as a didactical resource. Firstly, parents like the AR technologies because they regard it as useful, facilitating the learning process and promoting motivation, knowledge, reading and writing, creativity and degree of satisfaction. Secondly, parents think that there are a lot of benefits in using a technological tool based on AR: the integration of several components in order to achieve a common goal, the possibility of managing the execution of the exercises in several contexts, or the availability of the system, among others. Thirdly, parents find that AR didactical resources allows to work children with different levels of difficulty which has shown to be useful in increasing comprehension. Fourthly, the families believe that the children who used the AR technology improve their reading and writing skills, so important in preschool education, therefore kids could obtain better final grades [54].

Tuli and Mantri [34] aimed to develop usability principles for mobile based AR applications for kindergarten kids. In their research work they reached their aim and categorized developed principles into 4 groups namely cognition, orientation, design and support. The authors give the definition of the created groups as follows:

1. Cognition: This group includes usability principles related to cognitive and intellectual aspects which improves thinking skills of the child like learnability, efficiency, reducing short term memory load, etc.
2. Orientation: This group includes the principles which define kid's understanding/interaction with the application such as enjoyment, customizability etc.
3. Design: This group includes the principles related to usage of the application by the children like interactive, simplicity etc.
4. Support: This group includes the principles related to the user support including error management, early test etc. [34].

In Nezhyva et al. [44] opinion, AR technologies application during the reading and writing lessons in primary school contributes to the effectiveness of learning in different directions, in particular: creates a Wow-effect and deepens emotional resonance from reading a work of art; becomes a powerful motivation for the reader's activity; compensates for the lack of development of the creative imagination of younger students; provides perception of artistic image by different sensory organs; activates students' interest in reading fiction; demonstrates to students the benefit of gadgets for learning and personal development.

Panchenko et al. [24] examine the problem of educators' training for using the AR books in educational process. Scholars referred to the results in previous author works on the potential of the massive open online courses (MOOCs) about AR, and mentioned their researches about content and program of the specialized course "Augmented Reality as a Storytelling Tool" for the professional development of teachers, and the difficulties of using storytelling in education and ways to overcome them. The authors highlight the need to use AR technologies in education because it can provide modern education with new didactic measurements and tools, will facilitate the co-creation of students and teachers, contribute to a better understanding of subjects, visualize hidden processes, and make it acceptable for adults and people with disabilities. The researchers define an AR textbook as a new educational tool which can contain fragments

of video lectures, electronic pads (for example, Padlet), augmented quizzes, 3D models, animated tours in the history of the studied problem, in-depth exercises, didactics games etc. The authors complement the specialized course “Digital Storytelling in Adult Education” for the system of professional training and retraining of educators with AR book creation module [24].

Tarasenko et al. [32] proclaim that the using AR technologies allow a person to quickly find and receive information about real objects, which can be represented in a symbolic, sound, graphic or animated form . They investigated the problem of the usage of AR elements for the formation of students’ communicative competence through a virtual tour. According to their survey the use of virtual excursions with AR elements increased the students’ interest and motivation to learn a foreign language. The authors trace the improving of the effectiveness of training and longer memorization of the studied content which is achieved through higher motivation for learning, the student’s independent actions and his/her emotional impression, active, and direct interaction with a real educational object based on AR technologies. The researchers state that the usage of AR technologies requires appropriate methodological didactic reorientation to create the opportunity for students to independently organize research, collect, evaluate, process and present information, apply complex hypertext structures, develop network thinking, work within flexible, group, project-oriented forms of training. In their article such advantages of AR technologies using in learning foreign languages, in particular German, were identified:

- AR technologies allow to achieve a higher level of assimilation of educational material, because various channels of perceiving information are involved (audial, visual, kinesthetic etc.);
- the student gets a more complete picture of the studied object due to the integrity of its representation, and then faster memorize new words, especially terminology, which remain in memory longer since are used in context;
- AR technologies application helps the students get know the spatially remoted objects, and understand the essence or purpose of these objects and remember the vocabulary associated with them;
- faster memorization of new vocabulary is supported by the parallel presentation of information case together with selected objects for study, which allows students to quickly receive extended information using AR technologies;
- the usage of AR technologies to conduct a virtual tour allow students to develop communicative foreign language skills, exactly during the work in a group;
- AR technologies are a good tool for learning a foreign language, because they allow the student to learn at his/her own pace [32].

Cadavieco et al. [55] concluded that a working environment where AR technologies can be used is an alternative to the traditional iconic resources (blackboard, computer, projectors, etc.), as they are enhanced by additional information. The authors categorize 4 types of AR applications:

Type 1 – Geolocation: image including details of its geographic location (GPS) and other relevant data such as information on public establishments, guidelines and suggestions of traffic routes.

Type 2 – Pattern/Tag/Marker/QR-Code/Semacode: image with data regarding a specific original pattern.

Type 3 – Image and software: this option allows differentiation between the key features captured by an application that turns them into measurements.

Type 4 – Recognition and browser: an image can be compared to related pictures on the Internet in order to add relevant information [55].

Thus, according to the analysis of scientific papers, the use of AR technologies has significant potential for the effective organization of the educational process of future teachers-philologists. AR technologies allow to visually reproduce the created learning environment and interact with it, to form modern digital competencies of future teachers of Ukrainian language and literature, to give emotional and cognitive-practical experience, which helps to involve students in the systematic acquisition of professional knowledge and competencies.

## **2.2. Features of creating AR in the professional training of students-philologists**

The specificity of AR technologies application in the discipline “Methodic of teaching literature” is the ability to create such a reality with reference either to the marker image (AR will be read only from a specific image anywhere and at any time), or to geolocation (AR will be read only in the place where it was created). For our educational needs we used that type which is based on marker image.

Pochtoviuk et al. [25] describe how AR based on the marker image works:

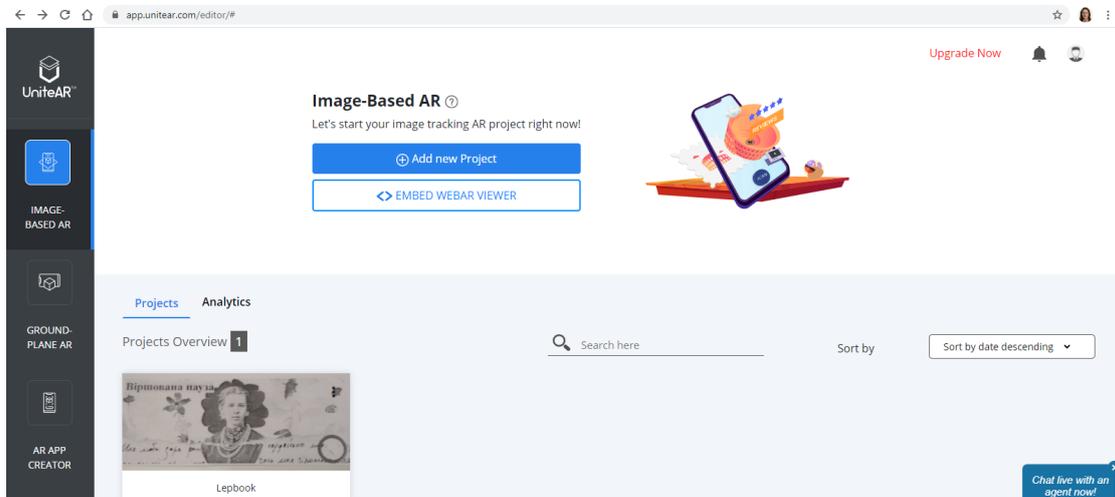
1. The camera finds a real-world marker and then transmits information about it to a tablet or smartphone.
2. Special AR application replace marker by virtual object (text, music, video, 3D model, etc.) and displays it on the screen.
3. The camera then tracks the movements of the marker, and the application allows you to control the objects.

The creation of AR during the study of the discipline “Methodic of teaching literature” was aimed at organizing the professional training of students-philologists with the help of trendy educational technology, so that they become familiar with the newest technologies and teaching methods, get ready to implement educational innovations in the educational process. But it is clear that the future teachers of Ukrainian language and literature should take into account the expediency of using a particular technology, which is needed not only for spectacular training, but also to achieve its effectiveness.

We describe the sequence of actions to create AR and its subsequent content filling. The example of our experience of the usage AR application in educational process with students-philologists is based on the existing free of charge trial version of software (such as the mobile application Unite for Android).

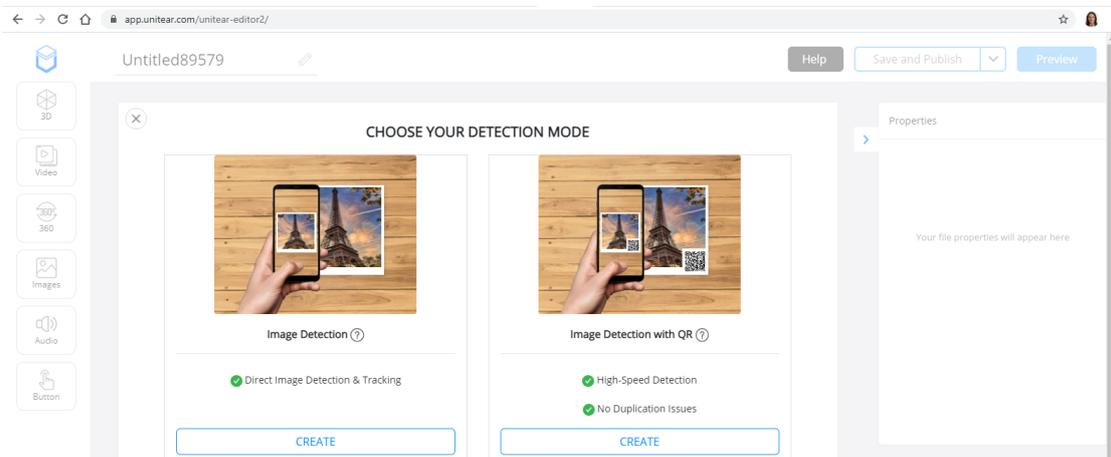
1. AR creation through the mobile application Unite on Android. To do this, download the application to your mobile phone, click on the button at the top left, select “Create AR”, register, i.e. create your own profile. In addition, you can also use the website <https://app.unitear.com> to create a new project with AR.

- The next step is to create your own project. To do this, select the “Image-Based AR” section on the left and click on the “Add new Project” button which is demonstrated in figure 1.



**Figure 1:** The interface of AR application Unite on PC.

- Then upload your target image. You can choose your detection mode between Image Detection and Image Detection with QR. We selected Image Detection and uploaded image in jpeg format (generally, supported format: jpeg, jpg, png) and up to 10 MB in size. The proposed choice between detection modes are shown in figure 2.

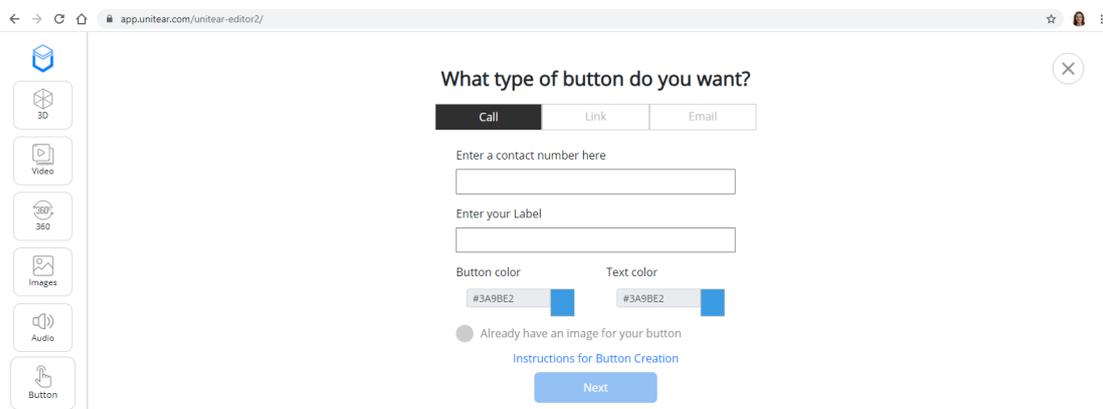


**Figure 2:** The choice between detection mode.

- Next, you can choose which AR effect will be applied to the image marker. Mobile AR

application Unite offers the following options:

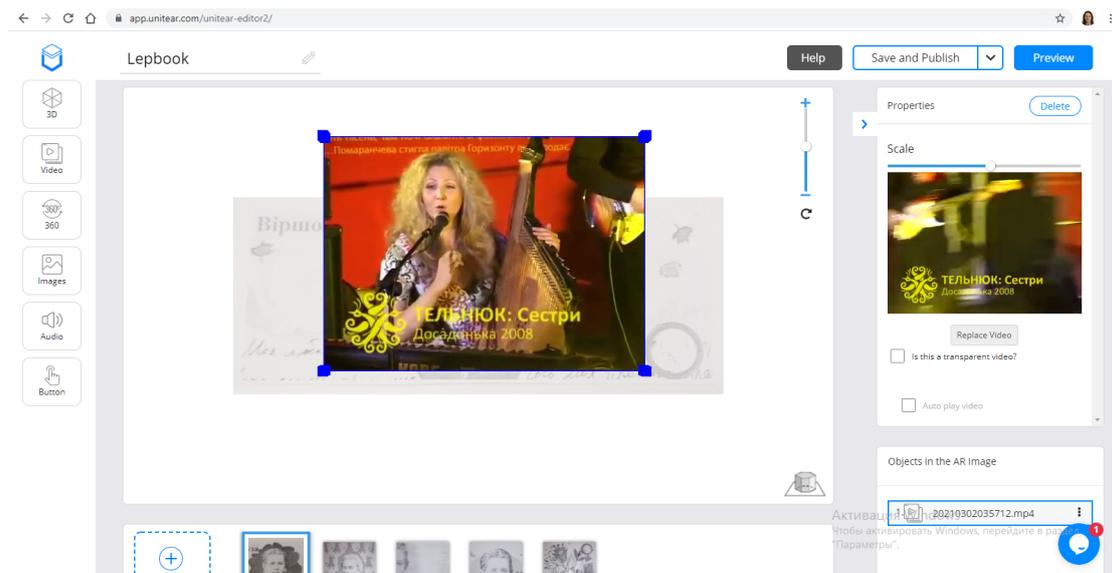
- Upload your 3D Model (Supported format: obj, fbx, glb, zip containing fbx with texture image folder);
- Upload your Video in mp4 format or Paste your YouTube Video Link;
- Upload your Panoramic Video in mp4 format or Image for 360-degree experience;
- Upload your Slideshow Images or Animated Gif (Supported format: png, jpg, jpeg, gif);
- Upload your Audio files in wav, mp3 format and hear it when a user scans the target image;
- Create your own Button. Here you can select the type of your button (Call, Link, Email) and enter the required data and your Label, select Button color and Text color or download the finished image for the button (figure 3).



**Figure 3:** The choice of the type of button.

5. After downloading certain content, you can align its position relative to the base image-marker.
6. New marker images can be added to the same newly created project and specific educational content can be superimposed on them (figure 4). Once the project is completed, you can view and save it. The advantage of this program is the ability to return to the project and, if necessary, edit it.

The implementation AR technologies in learning process requires to be arranged pedagogical in a significant way (considering the student's age and his/her former knowledge and skills, and by the logical structure of the topic to be taught). Students-philologists join the creation of AR during studying the discipline "Methodic of teaching literature". Thus, the future teachers of Ukrainian language and literature become proficient in the newest technologies on their own, master the skills needed for a teacher of the 21st century, learn to work both individually and in a group, present their work on a public, improve knowledge both in professional subjects and in English (AR application interface is in English only).



**Figure 4:** The overlay the educational video content on image marker.

### 2.3. Features of the methodic of using AR based on a lepbook

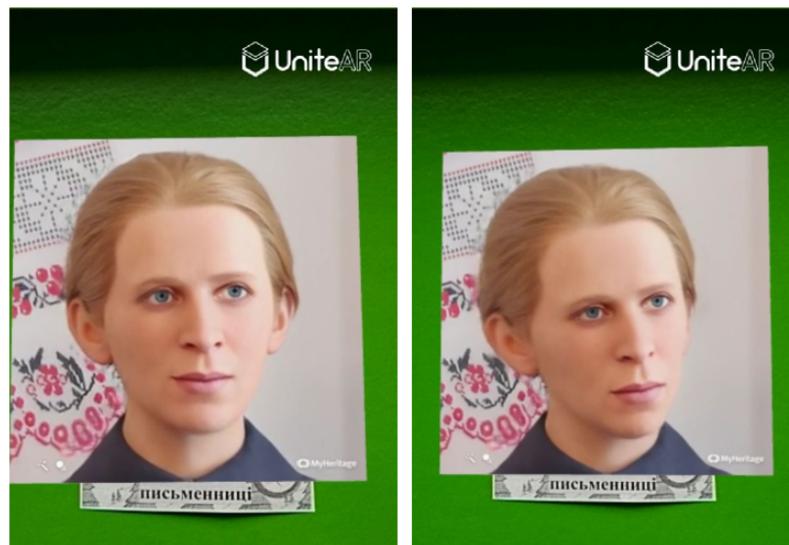
Choosing organizational methods, techniques and forms of teaching [56], we give preference to creative elements over reproductive ones in educational activities of future teachers of Ukrainian language and literature. That motivate students to further develop their professional and creative qualities and form their experience of pedagogical creativity. Because, as Kucevol [57] points out, the peculiarity of creative professional activity is that its experience cannot be transferred by informing or illustrating, but its only acquired during the personal students' involvement in creative work.

We will reveal the features of the implementation of ICT, in particular AR technologies, during practicum on “Methodic of teaching literature”. We offer to your attention a fragment of a practical class “Methods and techniques of teaching literature”, which was aimed at forming students' understanding of the classification of methods and techniques of teaching literature by modern methodologists, analysis of methods of introducing innovative and information and communication technologies in the work of teachers-philologists.

To get acquainted with AR technologies, at first students-philologists were asked to create the lepbook “Incredible Lesya Ukrainka”. Most of the information pockets of the lepbook were made with elements of augmented reality. Among them are the following rubrics: “Biography of the writer”, “Surrounding of Lesya Ukrainka”, “Poetic pause”, “Lesya Ukrainka in the 21st century”, “And you know...”.

To visualize the educational material for the rubric “Biography of the writer”, students-philologists created an animation of Lesya Ukrainka's photo using the Deep Nostalgia function on MyHeritage. With this technology, you can animate faces in historical photos and create high-quality, realistic videos that reproduce the movements of a person on a photo in such a

way you can see how this person smile, blink, and turn her head. This AR animation is shown in a figure 5.



**Figure 5:** The demonstration of AR animation in the rubric “Biography of the writer”.

Next development of the AR will help to deepen the students’ knowledge about Lesya Ukrainka’s surrounding by clicking on the “11 Lesya’s friends” button and then following the hyperlink (figure 6).



**Figure 6:** The demonstration of AR link button in the rubric “Surrounding of Lesya Ukrainka”.

The AR content in the rubric “Poetic pause” was a video of the performance of the musical band “Sisters Telnyuk” with the song “Dosadon’ka” on the words of the poem by Lesya Ukrainka “Oh, it seems – I’m not in a sorrow...”. That is demonstrated in figure 7.



**Figure 7:** The video demonstration of AR in the rubric “Poetic pause”.

With the help of AR technologies, students-philologists were able to visualize the most popular modern illustrations of the writer’s image by illustrators and artists in the 21st century. They are shown in a figure 8.

Next rubric “And you know...” thanks to AR technologies presents a sound recording of Lesya Ukrainka’s singing (figure 9).

We specifically used black and white marker images. This was done to achieve a greater effect from the visualization of AR. After all, superimposed educational content is bright and colored videos, animations, images, etc. So, at first students perceive the seen lepbook as a usual traditional way of bringing educational material to learners, but everything changes after instructions to download the AR application Unite and to create their new project, then to aim the camera at the marker image and to read the AR. The black and white marker image seems to come to life. This causes an unforgettable, strong emotional impact on students-philologists, fascinates them, arouses the desire to create AR again during the studying the discipline, and in further professional activities.

### **3. Conclusions and prospects for further research**

We are convinced that the effectiveness of professional training of the future teachers of Ukrainian language and literature to professional activity directly proportionally depends on



Figure 8: AR content in the rubric “Lesya Ukrainka in the 21st century”.

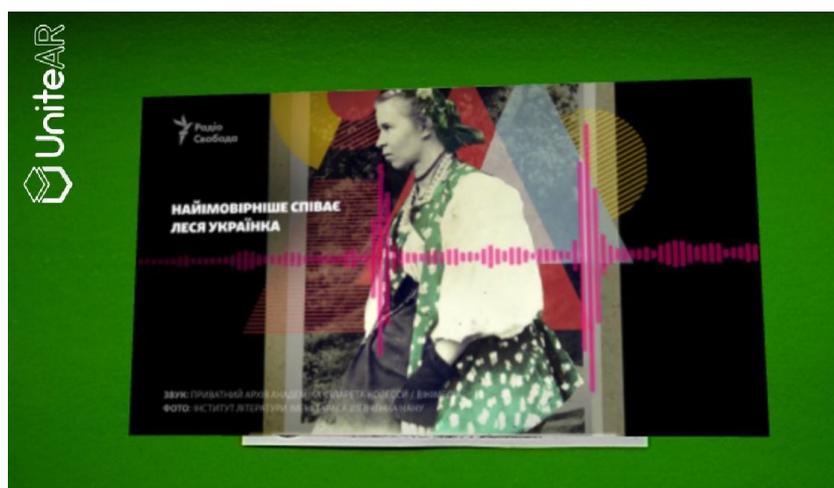


Figure 9: AR audio content in the rubric “And you know...”.

the usage of ICT in the learning process, especially AR technologies, which modernizes the studying and activates students to research and creative work, arouses their desire for self-development, self-education and professional self-realization etc. In addition, the usage of AR technologies provides an emotional and cognitive experience that helps to involve students in systematic learning.

With the help of AR technologies, the usage of a lepbook permits students to improve the assimilation of theoretical material, allows to deepen it and contributes to its better illustration,

which in turn increases students' cognitive activity and develops their creative thinking. Using a mobile phone or tablet allows students to reproduce AR on the marker images which are placed on a lepbook anywhere and anytime. AR technologies don't require being in front of a computer or laptop. The only condition is the availability of the Internet.

Mobile AR application Unite provides the ability to visualize educational content of the lepbook "Incredible Lesya Ukrainka", made by students-philologists at the Mykhailo Stelmakh Faculty of Philology and Journalism of Vinnytsia Mykhailo Kotsiubynskyi State Pedagogical University during the studying the discipline "Methodic of teaching literature".

Thus, AR technologies help in the practice-oriented professional development of the future teachers-philologists and their self-improvement during preparation for educational activities.

A prospects area for further research is the study of the possibilities of using AR technologies in lessons of Ukrainian literature at secondary school.

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